Engineering Library

JUL 11 1927

ARMY ORDNANCE

VOL. VII WASHINGTON, D. C., MAY-JUNE, 1927 No. 42

GUARDING THE ENTRANCE TO NEW YORK HARBOR *International Newsreel*

SOME LOST OPPORTUNIIIES OF THE CIVIL WAR
Col. Frank A. Scott, Ord. Res., U. S. A.

CHARLES M. SCHWAB CN THE ORDNANCE PRCBLEM

BOMBS AND BOMB FUZES
Lieut. W. E. Becker, Ord. Dept., U. S. A.

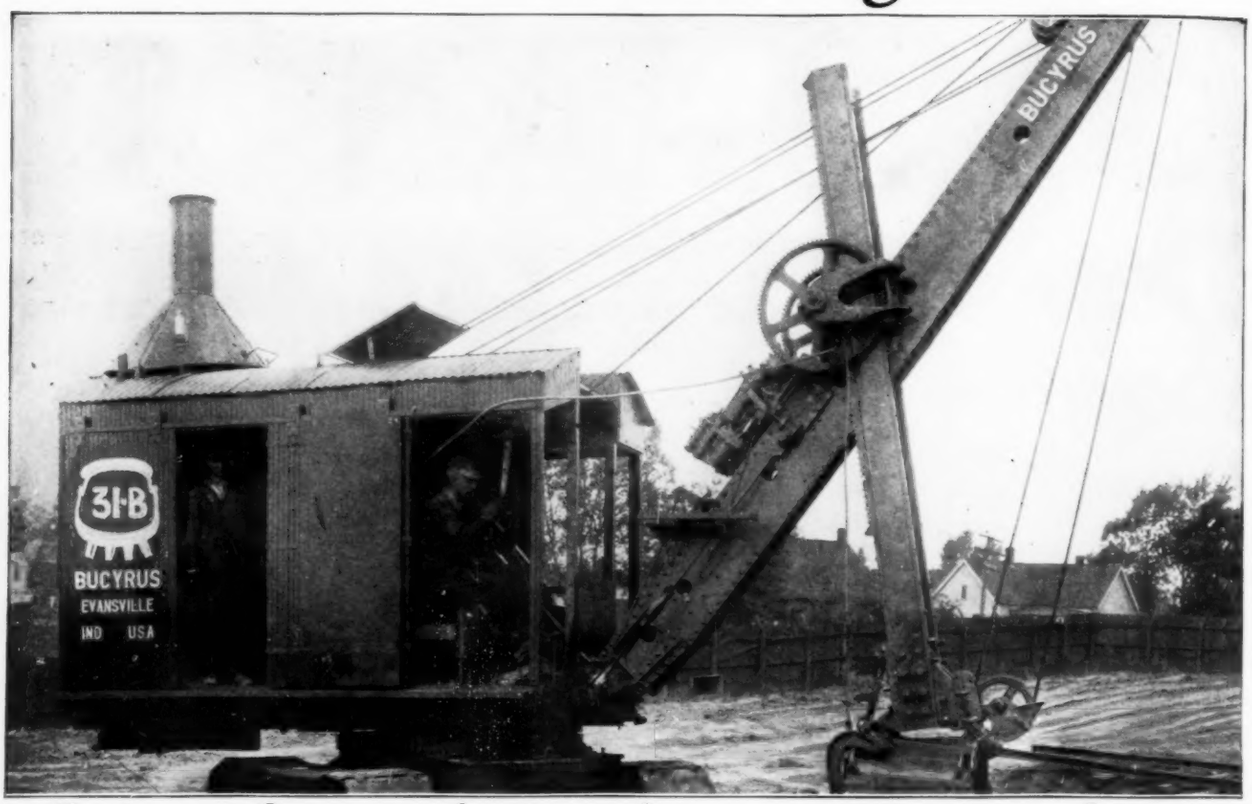
THE COMMON DEFENSE
Maj. C. G. Mettler, Ord. Dept., U. S. A.

TOOL TESTING AS A BASIS FOR ORDNANCE PURCHASES
Maj. Carlos de Zafra, Ord. Res., U. S. A.

ARMY ORDNANCE ASSOCIATION PRIZE ESSAY:
EXPLOSIVES—PAST AND PRESENT
Cadet Edward M. Chamberlain, U. S. M. A. '27

AOA
THE JOURNAL OF THE ARMY ORDNANCE ASSOCIATION

The new 31-B *does* dig faster



Swings faster—hoists faster—operates faster

The high-speed digging cycle of this 1-yard Bucyrus gives you more dipperfuls per hour—greater daily yardages at lower cost per yard.

On one basement job the new 31-B loaded as high as 42 trucks per hour, *and excavated 900 yards in 7 hours.* The light, sturdy, Bucyrus box girder boom and the corresponding lighter counterweight reduces the fly-wheel action. As a result the 31-B swings the loaded dipper faster.

And the famous Bucyrus outside dipper handles thrust the dipper squarely into the bank for a heaped measure at every pass. A two part hoist lifts the loaded 1-yard dipper faster.

If you're going to buy a convertible 1-yard shovel, check the things you want and compare them with what the New Bucyrus 31-B can give you. The New C-311-AC Bulletin has the information. Write for it today.

BUCYRUS COMPANY, South Milwaukee, Wisconsin

BUCYRUS

NEW YORK CHICAGO BIRMINGHAM SAN FRANCISCO PITTSBURGH TOKYO LONDON

768

Pledged to Public Service in Effecting Industrial Preparedness for War as Our Strongest Guarantee of Peace

ARMY ORDNANCE

THE JOURNAL OF THE ARMY ORDNANCE ASSOCIATION

EDITORIAL STAFF
MAJ. C. R. BAXTER, Ord. Dept., U. S. A.
Editor
CAPT. L. A. CODD, Ord. Res., U. S. A.
Associate Editor

MAJ. JOHN A. BROOKS, Ord. Dept., U. S. A.
MAJ. W. A. GANOE, Inf., U. S. A.
WILLIAM N. ROACH
MAJ. T. A. CLARK, Ord. Dept., U. S. A.
MAJ. PELHAM D. GLASSFORD, F. A., U. S. A.

Published by
THE ARMY ORDNANCE ASSOCIATION
806 Mills Building, Washington, D. C.

Issued Bi-Monthly. Single Copy 75c.

Subscription rate: Continental U. S. $1.50 per annum, foreign $5.00, in advance; Entered as second class matter August 14, 1920, at the Post Office at Washington, D. C., under the Act of March 3, 1879. Additional entry at Richmond, Va.

Volume VII **MAY-JUNE, 1927** **Number 42**

CONTENTS

Col. Henry L. Stimson, Counsel, Army Ordnance Association . . . . . Frontispiece
Some Lost Opportunities of the Civil War . . By COL. F. A. SCOTT, Ord. Res., U. S. A. 407
"Ordnance Problem is the Crux of Our National Defense"—Charles M. Schwab Tells West Point Cadets During Engineering Societies' Visit 414
Bombs and Bomb Fuzes . . . . . By LIEUT. W. E. BECKER, Ord. Dept., U. S. A. 417
The Common Defense . . . . . By MAJ. C. G. METTLER, Ord. Dept., U. S. A. 426
Gen. Guy Eastman Tripp 431
Tool Testing as a Basis for Ordnance Purchasing By MAJ. CARLOS DEZAFRA, Ord. Res., U. S. A. 432
Ordnance in the Orient 436
Explosives—Past and Present . . By CADET EDWARD W. CHAMBERLAIN, U. S. M. A. '27. 438
Ordnance News in Pictures 441
Editorial 442
General Tripp—Lindbergh Points a Moral.
Professional 444
The Restabilization of Pyrocotton Deteriorated in Storage—German Long Range Guns—Death of Deport Recalls Long Secret Development of French 75-mm. Gun—Smokeless Powder Containing Centralite.
Personnel 450
Philadelphia Post Meeting—Maj. R. A. Bull to Receive Joseph F. Seaman Gold Medal—Ordnance Course for Reserve Officers at Stanford University—W. Kesley Schoepf—Major Maxwell Addresses Reserve Officers—Summer Training Camps for Ordnance Reserve Officers—Ordnance Reserve Officers Attend Spring Training—Recently Commissioned Ordnance Reserve Officers—Recently Assigned Ordnance Reserve Officers.
Historical 457
Early History of Ordnance Department, U. S. A.
Cadets Make Annual Visit to Aberdeen Proving Ground and Frankford Arsenal . . . 458
Patents 459
Books 461

"The increasing interest all over the nation in industrial preparedness is a frank declaration to the world that we not only want peace but that we intend to have it."

HANFORD MACNIDER, *Assistant Secretary of War.*

ARMY ORDNANCE ASSOCIATION

806 Mills Building, Washington, D. C.

OFFICERS

President
HON. BENEDICT CROWELL
Cleveland, O.

Vice-President
COL. WILLIAM W. COLEMAN, Ord. Res.
Milwaukee, Wis.

Vice-President
GEN. GUY E. TRIPP
New York, N. Y.

Counsel
COL. HENRY L. STIMSON

Secretary
MAJ. CHAS. R. BAXTER, Ord. Dept., U. S. A.
Washington, D. C.

Treasurer
COL. CHAS. ELLIOT WARREN, C. A. Res.
New York, N. Y.

DIRECTORS

ROBERT P. LAMONT
Chicago, Ill.

FRANK A. SCOTT
Cleveland, O.

SAMUEL McROBERTS
New York, N. Y.

CHARLES H. TENNEY
Boston, Mass.

WALDO C. BRYANT
Bridgeport, Conn.

C. L. HARRISON
Cincinnati, O.

JAMES L. WALSH
New York, N. Y.

BRUCE CORNWALL
San Francisco, Calif.

CASPER H. ROWE
Cincinnati, O.

WILLIAM C. SPRUANCE
Wilmington, Del.

THE Army Ordnance Association is a national organization of American citizens pledged to industrial preparedness for war as our nation's strongest guarantee of peace.

THE Association endeavors to keep alive an interest in and knowledge of the design, production and maintenance of munitions. Other than a few manufacturing arsenals—six in all—there is no peace-time industry for the production of ordnance. Should war unhappily come again, industrial America will be called upon to produce munitions in great quantity and of intricate and unusual design. In an emergency time will not permit careful study or long preparation for the production of munitions. The problem is one of vital concern.

THE Army Ordnance Association believes that the solution of this problem, based on experience, lies in an active organization at all times cooperating with the Government. The principal objective of the Association is an active membership of American citizens, on whom the duty of design and production of munitions will fall in war, who will have an accurate and authentic knowledge of the complex requirements of ordnance. "Peace Insurance" in this form is the foremost aim of the Army Ordnance Association.

THE Association is purely patriotic; it has no commercial interests, no political alliances, and no religious affiliations. It is not operated for profit: its income is expended in furthering its aims. Its officers and directors serve without remuneration.

ARMY ORDNANCE, the journal of the Association, is published solely for the purpose of disseminating information on the progress of our munitions developments so that American industry may at all times know its responsibilities to the common defense.

The objectives of the Association as set forth in its Constitution are:

To assist in effecting industrial preparedness for war as being one of the nation's strongest guarantees of peace;

To keep available the highly specialized knowledge necessary for arming the manhood of the nation by stimulating interest in the design and production of ordnance material;

To promote mutual understanding and to effect cooperation with American Scientists, Inventors, Engineers and Manufacturers in civil life and the Regular and Reserve Officers of the Army Ordnance Department;

To provide, when required, the services of competent committees to investigate and report upon special ordnance subjects;

To assist in developing and maintaining an efficient personnel, both commissioned and enlisted, for the units required for Ordnance Field Service in the event of an emergency;

To commemorate the services rendered by the Industry of the Nation and by the Officers and Civilian Employees of the Ordnance Department in the wars in which the United States has been engaged.

Communications should be addressed to
THE SECRETARY, ARMY ORDNANCE ASSOCIATION
806 Mills Building, Washington, D. C.

LOCAL POSTS A.O.A.

NEW YORK

(*Organized June* 15, 1921)

President: GEN. GUY E. TRIPP. *Vice-Presidents:* COL. SAMUEL HOF, Ord. Dept., U. S. A., COL. JAMES L. WALSH, Ord. Res., LT. COL. R. D. COOMBS, Ord. Res., LT. COL. H. B. MACHEN, Ord. Res. *Executive Committee:* GEN. GUY E. TRIPP, *Chairman*, JAMES A. FARRELL, COL. SAMUEL HOF, Ord. Dept., U. S. A., COL. J. L. WALSH, Ord. Res., COL. C. E. WARREN, C. A. Res., LT. COL. H. B. MACHEN, Ord. Res., LT. COL. R. D. COOMBS, Ord. Res., LT. COL. E. L. SHERWOOD, Ord. Res., MAJ. EARL MCFARLAND, Ord. Dept., U. S. A., MAJ. C. E. DAVIES, Ord. Res., MAJ. J. M. BOYLE, Ord. Res., CAPT. C. H. KECK, Ord. Dept., U. S. A., MAJ. P. R. FAYMONVILLE, Ord. Dept., U. S. A. *Treasurer:* CAPT. C. H. KECK, Ord. Dept., U. S. A. *Secretary:* MAJ. P. R. FAYMONVILLE, Ord. Dept., U. S. A., 39 Whitehall Street, New York City.

CALIFORNIA

(*Organized October* 17, 1923)

President: PLINY E. HOLT. *Vice-President:* COL. CHARLES N. BLACK. *Directors:* FRED BOEGLE, JR., COL. BRUCE CORNWALL, Ord. Res., LT. COL. J. C. SCRUGHAM, Ord. Res., COL. D. C. SEAGRAVE, Ord. Res., W. E. CREED, D. C. JACKLING, W. H. OLIVER, REESE LLEWELLYN. *Secretary:* MAJ. M. L. BRETT, Ord. Dept., U. S. A., 58 Sutter Street, San Francisco, Cal.

CHICAGO

(*Organized May* 3, 1924)

President: E. A. RUSSELL. *Vice-President:* E. J. BUFFINGTON. *Directors:* COL. R. P. LAMONT, COL. H. C. BAYLESS, Ord. Res., COL. W. W. COLEMAN, Ord. Res., LT. COL. CLAUDE E. FITCH, Ord. Res., MAJ. A. G. GILLESPIE, Ord. Dept., U. S. A., CAPT. WALTER H. DAMON, Ord. Res. *Treasurer:* MAJ. WILLIAM R. WRIGHT, Ord. Res. *Secretary:* CAPT. W. H. SODERHOLM, Ord. Dept., U. S. A., 600 W. Jackson Boulevard, Chicago, Ill.

BOSTON

(*Organized June* 30, 1925)

President: COL. EDWARD F. MILLER, Ord. Res. *Vice-President:* ALVAN T. SIMONDS. *Directors:* LT. COL. F. A. ESTES, Ord. Res., MAJ. M. M. OSBORNE, Ord. Res., MAJ. J. S. SMYSER, Ord. Res., G. L. GILMORE, EVERETT MORSS, MAJ R. F. WHITELEGG, Ord. Res. *Treasurer:* LT. COL. JERE. CAMPBELL, Ord. Res. *Secretary:* CAPT. L. P. CRIM, Ord. Dept., U. S. A., 200 Devonshire Street, Boston, Mass.

WASHINGTON

(*Organized November* 18, 1925)

President: GEN. JAMES A. DRAIN. *Vice-President:* MAJ. C. G. METTLER, Ord. Dept., U. S. A. *Secretary-Treasurer:* CAPT. L. A. CODD, Ord. Res., 806 Mills Building, Washington, D. C.

CINCINNATI

(*Organized December* 9, 1925)

President: J. WALLACE CARREL. *Vice-President:* LIEUT. COL. A. H. PUGH, JR., Ord. Res. *Directors:* COL. C. L. HARRISON, Ord. Res., FREDERICK W. HINKLE, CAPT. H. L. CAMPBELL, Ord. Dept., U. S. A. *Treasurer:* CAPT. R. S. BARR, Ord. Dept., U. S. A. *Secretary:* CAPT. H. L. CAMPBELL, Ord. Dept., U. S. A., University of Cincinnati, Cincinnati, O.

PHILADELPHIA

(*Organized December* 9, 1926)

President: MAJ. JOSEPH A. STEINMETZ, Ord. Res., U. S. A. *Vice-President:* LIEUT. COL. ARCHIBALD B. HUBARD, Ord. Res., U. S. A. *Directors:* MAJ. JOHN Q. MACDONALD, Ord. Dept., U. S. A., CAPT. R. W. BOND, Ord. Res., U. S. A., J. L. POULTNEY, SAMUEL SHOEMAKER, J. W. ROBBINS, E. M. CHANCE. *Treasurer:* CAPT. F. C. SHAFFER, Ord. Dept., U. S. A. *Secretary:* LIEUT. T. R. SNYDER, Ord. Res., U. S. A.

SAINT LOUIS

(*Organized January* 18, 1927)

President: COL. HARRY SCULLIN, Ord. Res. *Vice-President:* LIEUT. COL. E. D. CAMPBELL, Ord. Res. *Directors:* J. M. KURN, J. W. JARBOE, A. J. DAVIS, E. D. NIMS, M. E. SINGLETON, W. F. CARTER, J. M. OLIN, H. I. FINCH. *Treasurer:* LIEUT. ALLEN MAY, J. A. G. Res. *Secretary:* MAJ. C. M. ROBERTS, Ord. Dept., U. S. A., Missouri State Life Insurance Bldg., St. Louis, Mo.

PITTSBURGH

(*Organized February* 24, 1927)

President: TAYLOR ALLDERDICE. *Vice-Presidents:* T. M. GIRDLER, J. FRANK DRAKE. *Directors:* RALPH M. DRAVO, LIEUT. COL. H. A. GIDNEY, Ord. Res., J. ROGERS FLANNERY, E. T. WHITER, H. P. DAVIS, FRANK B. BELL. *Treasurer:* MAJ. G. M. SIXSMITH, Ord. Res. *Secretary:* CAPT. FRED A. MCMAHON, Ord. Dept., U. S. A., 1014 Diamond Bank Bldg., Pittsburgh, Pa.

Col. Henry L. Stimson

Counsel, Army Ordnance Association

At the annual meeting of the Board of Directors, Army Ordnance Association, February, 1927, Col. Henry L. Stimson, Ex-Secretary of War, was tendered the office of counsel for the Association, vice Col. Ralph Crews, who died September 6, 1926. Colonel Stimson has accepted the appointment and has assumed the duties of legal adviser to the Association.

Born in New York City, Colonel Stimson was graduated from Yale, A. B., 1888, Harvard, A. M. 1890, Harvard Law School, 1890. Admitted to the bar in 1891, he became a member of the firm of Root and Clarke, 1893; Root, Howard, Winthrop and Stimson, 1897; Winthrop and Stimson 1901. Colonel Stimson served as Secretary of War in the Cabinet of President Taft, May, 1911, to March 5, 1913. He was commissioned a Major, Judge Advocate General Reserve, March, 1917; Lieut. Colonel 305th F. A., August, 1917; Colonel, 31st F. A., August, 1918, serving with the American Expeditionary Forces in France from December, 1917, to August, 1918.

Colonel Stimson recently returned from Nicaragua where, as special representative of the President of the United States, he negotiated a cessation of hostilities between the warring factions of that country.

ARMY ORDNANCE

VOL. VII MAY-JUNE, 1927 No. 42

Some Lost Opportunities of the Civil War

Col. F. A. Scott, Ord. Res., U. S. A.*

MOST campaigns and battles suggest lost opportunities for one of the opposing parties. It is in the consideration of these that the student of military history finds his chief interest, and one of his greatest opportunities for advancing his knowledge of the military art.

It may be unnecessary for me to remind this group** that such a discussion of lost opportunities as might have military value could only be made by a staff study of each action, involving the strategy, tactics, terrain, maps, and orders used by each side, with forces, lines of supply, possibilities of retreat, pursuit, etc., all included in the data examined. The present appraisal must rest chiefly upon the opinions of participants or of contemporary writers.

It will assist the formation of an opinion as to opportunities afforded the combatants in the American Civil War if we first attempt to visualize the general situation.

A population of twenty millions endeavoring to subdue a population of four to five millions of whites, and about three millions of blacks—the blacks mostly slaves, but loyal to their masters: the North being the invaders most of the time, operating in hostile country, hundreds of miles from protected bases, in an unknown territory but poorly supplied with roads and railroads.

Most of the great battlefields were in rough and wooded country, and at least three of the greatest battles—Chancellorsville, Chickamauga, and the Wilderness—on fields obscured with timber and underbrush. One of the best and most intelligent of the volunteer general officers—Maj. Gen. Jacob D. Cox—states in his memoirs that from beginning to end, the best field of fire for small arms which he saw on any battlefield was at Franklin, Tenn., approximately four hundred yards.

Most of the leaders on either side were men of the same nationality, with similar training, experience, and outlook. The mass of the soldiery, North and South, was of the same nationality, equally untrained and inexperienced in the beginning. Training and experience proceeded equally as each side schooled the other. Such conditions assured the probability that the forces would develop similarities of strength and weakness. If I had to attribute the lost opportunities of either side to a single cause, I should charge them to poor staff work. Again and again we find the explanation of inaction or faulty action to be the failure to obtain or appraise information; failure correctly to issue or transmit orders; ignorance of terrain where knowledge might have been acquired, and other evidences of ill-trained or insufficient staff officers.

There are certain lost opportunities that now seem to be indicated so plainly as to be beyond controversy; there are other cases in which the evidence is so well balanced as to make decision very difficult, and still others that become mere matters of opinion. Of course, it is out of the question, in a single discussion, to list all these instances.

Among those which I must with regret omit are: the slow march of McDowell to the battlefield of first Bull Run. Would he have won if that action had been fought one day earlier?

The "lost order" of Lee, found and delivered to General McClellan at Frederick, might have changed the course of the war. I shall not discuss it, although it would be a fruitful subject. Should McClellan have moved straight into Crampton's Gap and divided Lee's army? Could he have done so? Apparently he felt that his troops were not equal to the effort, but did he call on them to make the effort? Was his information such as to make immediate decisive action imperative? May we judge, from what Grant did at Donelson, when he discovered that the Confederates who made the sortie from that fort had their haversacks filled with food, what he might have done in McClellan's place?

Could McClellan have destroyed Lee's army at Antietam, after it was reunited, if he had attacked promptly and put in all his force?

Could McClellan have delivered a successful assault the day after Malvern Hill? There is much to indicate discouragement and disorganization in the Confederate army on that day.

All these questions and many more must be left out of the present discussion. Our embarrassment arises from the wealth of material. The spring flows too freely. It was a war of lost opportunities.

This was a civil war. Neither side knew the degree of purpose of the other, nor the punishment which one must inflict on the other before it could impose its will. There was no precedent available for the political and military leaders. Therefore, certain opportunities, to us quite obviously lost to the combatants in the beginning, can hardly be said to have existed at that time, as the possibility of being forced to conduct war on so vast a scale was not only not recognized, but, in the then state

*Colonel Scott is Chief of the Cleveland Ordnance District. During the World War he rendered preeminent service first as Chairman of the General Munitions Board and later as Chairman of the War Industries Board. He has been a Director of the Army Ordnance Association since its organization in 1919.—Editor.

**This paper was read by Colonel Scott before officers of the Ordnance Department and other branches of the War Department in Washington, March 21, 1927.—Editor.

of public sentiment, did not actually exist. Determination and the amplification of efforts grew with the progress of the war.

Had McDowell won Bull Run decisively the Confederacy might have collapsed. We must consider that it is more difficult for an incipient rebellion to overcome the consequences of defeat than for the established authority that has political and administrative machinery well developed and strengthened by long service.

In the field of strategy, the North had opportunities to control the sea, and to overwhelm the South by superior resources of men and material. It secured substantial control of the sea promptly, and complete control eventually. This opportunity was not neglected. The North eventually brought to bear the full pressure of its resources, but in the beginning it was feeble in this field. It depended on a volunteer army for a year after the Confederacy adopted conscription; and its neglect to exploit its resources for shipbuilding and especially for railroad construction and reconstruction is evidence of failure to appreciate these sources of power. Toward the end of the war these weaknesses were corrected.

The South had the great advantage of interior lines, such as was possessed by the Central Powers in the World War, with the opportunity to reinforce from side to side, and concentrate superior forces on desired points. Full exploitation by the Confederates of their advantage of the interior lines was never attained. They made some use of this opportunity, and when they did, it served them well. The most notable, possibly, was when they made transfer of Johnston from the Valley to Manassas to reinforce Beauregard at first Bull Run; the movement of Jackson's army from the Valley to reinforce Lee in front of Richmond, in May, 1862, and the transfer of Longstreet's Corps from Virginia to Tennessee, in September, 1863, to reinforce Bragg, a part of the Corps, with its Commander, arriving just in time to turn the tide, in the fierce fighting we call the Battle of Chickamauga.

In the opinion of some Confederate writers, especially Longstreet, the Confederate Government and Military Command either did not appreciate, or failed to take advantage of, the interior lines. Longstreet apparently suggested several movements from East to West, and it is very evident that on the one occasion when his suggestion was adopted—the movement to reinforce Bragg—it was successful.

In appraising the opportunity utilized or lost in any action, we would, of course, miss the point if we failed to consider the strategic object which provoked battle.

A drawn battle, while never satisfactory, may be almost as fatal to one side as a rout. Thus Antietam, claimed by certain writers as a drawn battle, was fatal to Lee's strategic conception of the Maryland campaign, which was to subsist on Northern territory, possibly capture a large Northern city, enlist the support of the State of Maryland, and, by a successful battle on Northern soil, win the all-important foreign recognition of the Confederacy.

The capture of Harper's Ferry, by Jackson, in the beginning of the Maryland campaign, appears a success until we recall that it was Lee's dispersion of his forces to accomplish this that gave the Federals their opportunity to check him at South Mountain, and defeat him at Antietam. It now appears entirely probable that if Lee had held his army together and fought one action, as at Gettysburg, he might have won. The Union Army had not recovered from Pope's disastrous campaign; McClellan had just been restored to command, and was in an even more precarious situation than Meade at Gettysburg. The threat of the Harper's Ferry garrison could have been masked or even ignored by Lee. Certainly nothing that Halleck, McClellan or Miles did about that force encourages us to believe that they would have used it effectively against Lee's rear or flank if he had not captured it.

Chickamauga is claimed by certain writers as a drawn battle, and even as a victory by General Rosecrans, inasmuch as he retained Chattanooga. Yet we know his object was to force Bragg to make a disastrous retreat south, instead of which Bragg cooped him up in Chattanooga with his discouraged and starving army. On the other hand, no writer can claim that Missionary Ridge and Lookout Mountain were drawn actions, as Bragg was by them forced into a disastrous retreat. Yet even in victory, Grant, at Missionary Ridge, lost an opportunity, according to one of his best lieutenants—Sheridan—for that vigorous and active general was persuaded that a pursuit, which he considered possible, might have ruined Bragg.

As examples of lost opportunities, where each side had a chance, it is not necessary to confine ourselves to great actions, such as Gettysburg and the Wilderness. Schofield's army, in November, 1864, retreating from the Duck River to the Harpeth River, on its way to reinforce Thomas at Nashville, passed the front of two corps of Hood's army encamped along the Columbia Pike; and there is testimony from both Confederate and Federal participants that the camp fires of the Confederates were plainly seen by the Federal soldiers marching on the Pike—and, yet, no attack was made by the Confederates on the flank of this retreating force.

On the very next night, after the disastrous attack by the Confederates on Schofield's army entrenched at Franklin, in which the losses of some of the organizations show the highest percentage of any Infantry losses up to that time, the Union Army, in pursuance of General Thomas' order, retreated from Franklin and joined him at Nashville. In the opinion of Maj. Gen. J. D. Cox, who commanded the lines at Franklin, a movement of one division forward from Nashville to Franklin would have enabled the Union Army to defend itself successfully against General Hood, and might have forced him into a retreat, which would have been his ruin. As it transpired, the Union Army retreated to Nashville; Hood followed it, and was destroyed there in the next month, but only after great apprehension and distress throughout the North.

One of the most disappointing efforts of the Army of the Potomac, in which both commander and troops were plunged from elation into deep discouragement, was the campaign of Chancellorsville under General Hooker in May, 1863.

Hooker, lying opposite Fredericksburg, divided his army into three sections. His cavalry was dispatched against

Lee's communications with Richmond; Sedgwick, with the 6th Corps, was left to assault Maryes Heights, behind the town, after the balance of Lee's army had been maneuvered out of position. Hooker, with the main body of his army crossed the Rapidan and began his march through the Wilderness on Richmond. His first moves were brilliant and he issued a boastful order; then came the period of uncertainty as to Lee's movements, due to the absence of the Federal cavalry; then followed Jackson's march across the front of the Federal army and his successful flank attack, which only ended when he received a fatal wound. The next day, a day of confusion, Hooker was injured and after that there ensued a brief period of paralysis of command which allowed the Confederates opportunity completely to recover from their earlier disadvantages and force a retreat of the Union Army across the Rapidan.

It is hardly possible to define the opportunity lost by Hooker at Chancellorsville, after Sedgwick's corps had captured Maryes Heights. The failure of General Hooker to direct his Army on that fatal day, or to transfer its command to some capable subordinate, if he found himself physically incapacitated, leaves everything in a mist of uncertainty. We can not conclude what would have resulted from certain decisions, for we have no light whatever on his alternative considerations. Just what controlled his decisions on that day, or what prevented them, is not disclosed by anything said or written then or since. Possibly the injury he had received, beclouded his mind so that even he never knew the true story of those fateful, disappointing, and, to the Federals, disastrous hours.

Only this is clear, that Hooker had succeeded in placing the Confederates at great disadvantage; Sedgwick obtained a real success; Hooker had the superior force and the chance to outfight and defeat Lee in a position which would have opened the way to Richmond and by a series of almost unaccountable mischances he threw the opportunity away.

The Battle of Gettysburg naturally occupies the most prominent place in a consideration of lost opportunities, because it is generally believed to have been the turning point of the War. While there were bitter days for the Northern cause after Gettysburg, it is perfectly safe to say that after that campaign the Confederate cause steadily declined. It makes the study of Gettysburg more interesting that each side claims to have missed a great opportunity. Dependable Confederate writers who were present at the battle, and some who bore great responsibilities, assert that the Confederates missed their greatest chance. On the other side, we have the evidence of President Lincoln's undispatched letter to General Meade; the reiterated suggestions and orders from General Halleck to General Meade, and the testimony of Gideon Wells, Secretary of the Navy, in his diary, to indicate that many of the responsible officers of the Government in Washington, from the President down, believed at the time, and continued to believe, that General Meade failed to do as much as reasonably could have been expected.

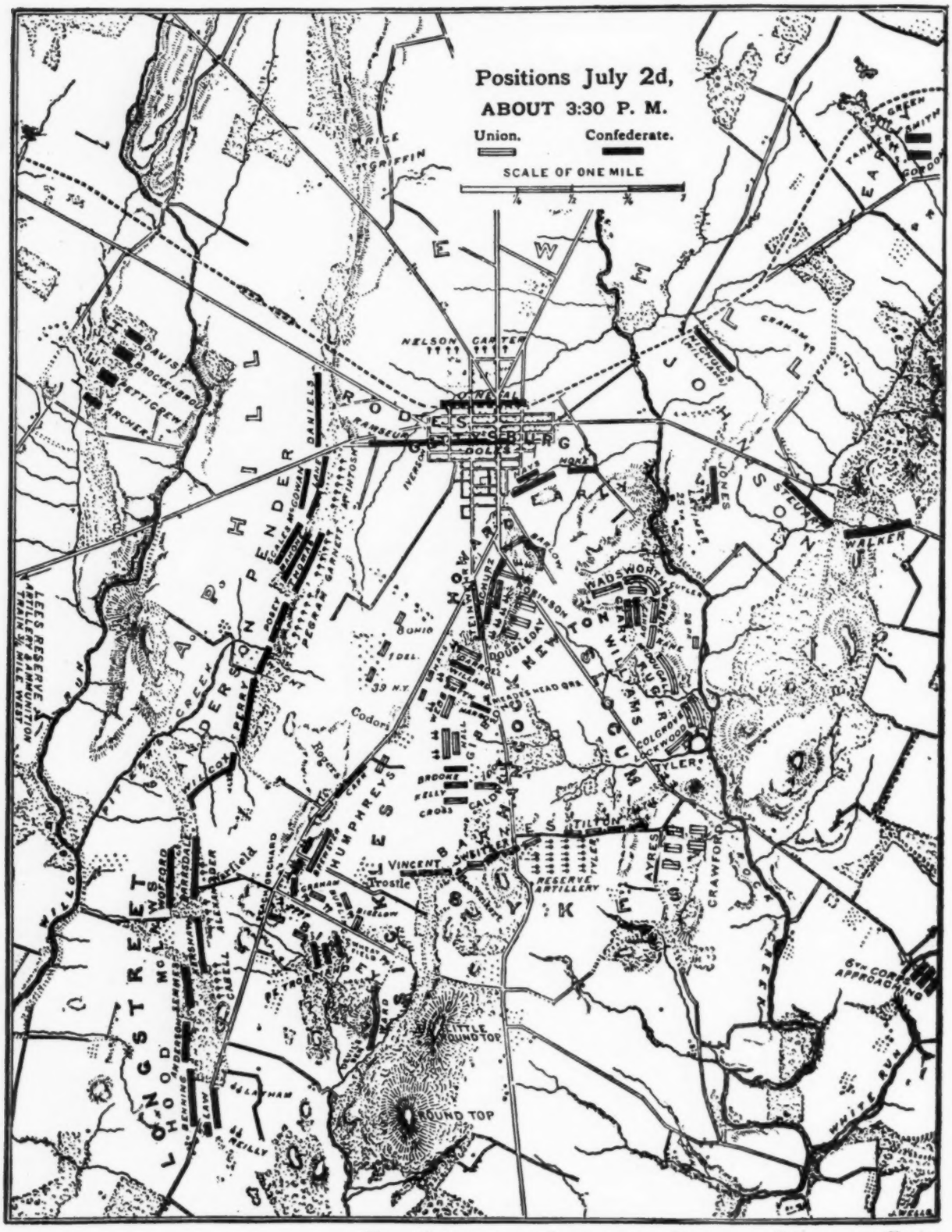
Among the Confederates, there is almost unanimous opinion that the success of the first day could have been followed up by an attack on the heights which commanded the town, and that an assault on those heights after three o'clock on the first of July would have been successful. Colonel Taylor, Adjutant General of the Army of Northern Virginia, has written: "I have always regarded our failure to push the advantage gained on the first day at Gettysburg, and to secure possession of the heights beyond the town, as a lost opportunity constituting one of the pivotal points upon which the fortunes of the Confederacy seemed to turn when hope of success was highest." Gen. J. B. Gordon, who was present on the field, and whose brigade had a prominent part in the defeat of the Federals in the mid-afternoon of the first day, is very positive that the heights could have been carried.

You will all recall that the failure to attack on the part of the Confederates was due to the wording of General Lee's order to General Ewell, in which he was "instructed to carry the hill occupied by the enemy if he found it practicable." (General Lee's official report of the Battle of Gettysburg.) General Longstreet's comment on the wording of this order is that General Ewell very properly refrained from making a movement which his commander-in-chief would not accept responsibility to order. It is rather a bitter comment!

After much careful study of the situation at the end of the first day, I am unable to reach a decision which I feel is sustained by indisputable evidence. The Confederates were in the flush of victory and the Federal forces about the town were defeated, undoubtedly. On the other hand there were fresh troops with artillery on the heights and more arriving constantly. Buford's cavalry was standing at the foot of the heights just outside the town. The Confederates were disorganized by their advance into the town and encumbered by several thousand prisoners.

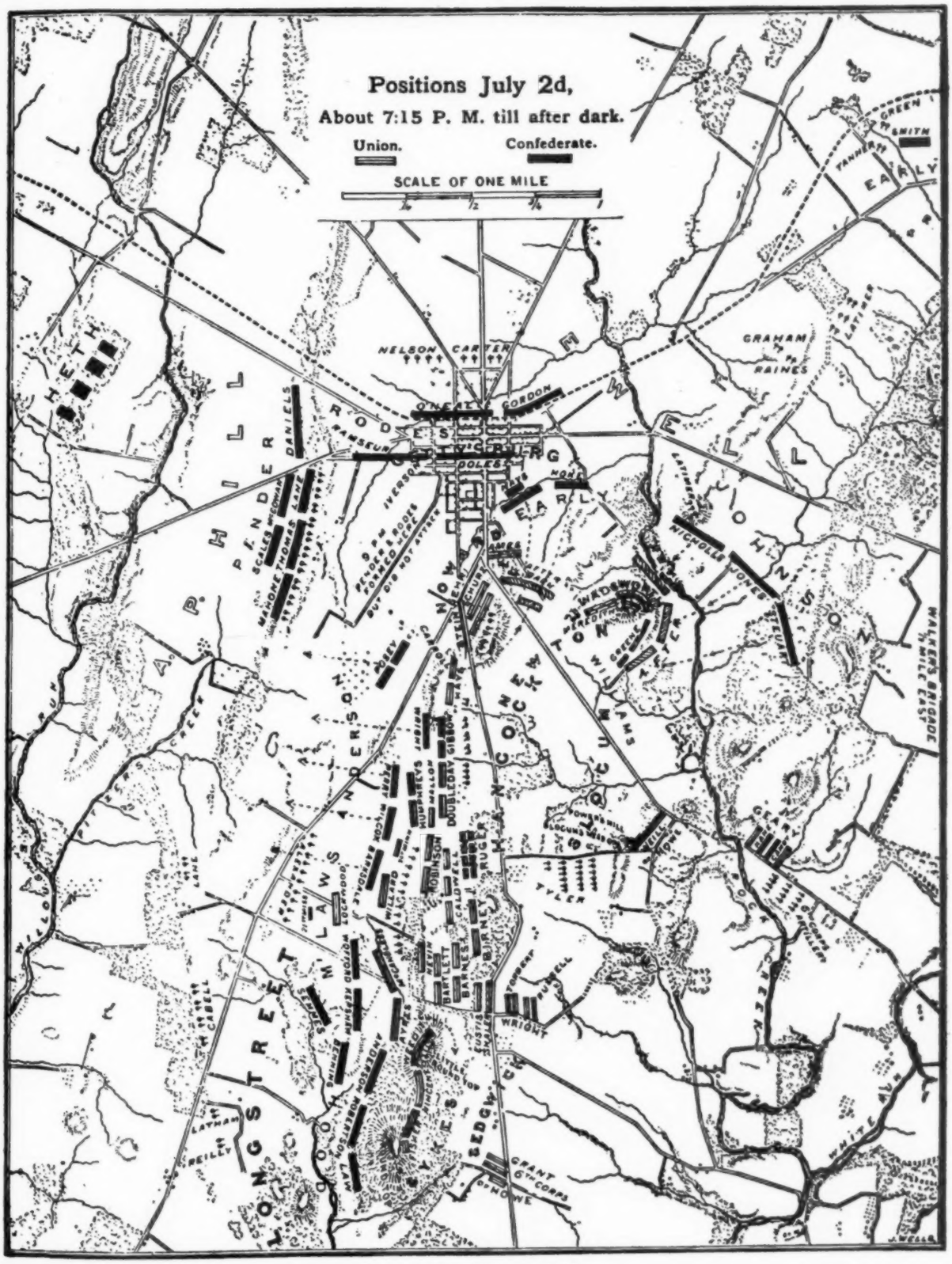
If Jackson had been in Ewell's place, we might admit immediately a lost opportunity for the Confederates. As it stands, we have Hancock on the heights and Ewell involved in confusion in and about the town. Ewell was a good soldier. The opportunity is suggested and left to his judgment and he rejects it.

The Confederate discussion of the second day indicates equal disappointment, and turns about the charge made against Longstreet that he could have attacked earlier than he did on the 2nd, and that an earlier attack would have carried the Federal lines before the occupation of the Round Tops. General Losgstreet might have attacked earlier on July 2; that is easily established. The earlier his attack, the smaller the Federal force ready to confront him; that is equally easily established. It will be remembered that both armies were marching to the battlefield, and arrived by brigades and divsions, almost from hour to hour, during the first two days. The problems that troubled General Longstreet, and that invite the scrutiny of the student are these: the formation of the land and the open nature of much of it viewed from the Federal lines on the heights made surprise attack impossible. Added to this, the Federals held the interior lines, and could reinforce from end to end faster than the Confederates could travel around the exterior lines. Longstreet's force available for attack was undoubtedly too small for its task at any hour on the 2nd, and while it is true that the Federal line was strengthened from hour to hour by fresh arrivals, it is equally true that Longstreet received accessions by delay. There was fail-



MAPS SHOWING THE OPERATION OF UNION AND CONFEDERATE FORCES

The map on the left shows the situation prior to Longstreet's attack which was delayed until after 4 P. M. It will be noted that the key positions on Round Top and Little Round Top are not occupied at this time by Union troops. The Confederates conducted a "piece-meal" attack starting with Hood's division on the right, followed by two brigades of McLaw's division about an hour later, and so on



ON THE SECOND DAY OF THE BATTLE OF GETTYSBURG, JULY 2, 1863

successively to the left. The map on the right shows the position of troops at the end of the day's fighting after Longstreet's delayed attack and Union troops in possession of the Round Tops. (The above maps are used through the courtesy of The Century Company, publishers of "Battles and Leaders of the Civil War," by Buel and Johnson—Editor.)

ure to coordinate the Confederate attack even after Longstreet began his battle, and this again brings in and emphasizes the point of poor staff work by the Confederates. The conclusion is that while some advantage may have been lost by delay on the 2nd, the chances of a clean-cut victory on that day were not present, and, therefore, there is nothing in the situation which justifies the classification of that day as a lost opportunity.

Why, then, do the Confederate writers insist so strongly that it was a lost opportunity? In my opinion this is due to their belief in the invincibility of the Army of Northern Virginia while commanded by General Lee. It had driven the Army of the Potomac in the Peninsula; it had defeated Pope's army at Cedar Mountain and Second Manassas; it had fought McClellan to a stand-still at Antietam; it had compelled Hooker to retreat from Chancellorsville; why, then, should it fail to drive the Federals before it at Gettysburg?

According to Confederate writers, Longstreet was unenthusiastic about the attack which he had been ordered to make. He was surly, and delayed on the ground that he wished to have all his available force in line before beginning battle. When battle was joined, the Confederates and not the Federals were fought to a stand-still. Therefore, it must have been Longstreet's delay which occasioned this break in the chain of victories. So reason most Confederate writers. It seems to me a curious fact that this group of distinguished Confederate leaders who discuss the lost opportunities at Gettysburg, and who sometimes in their disappointment assail one another, all overlook one tremendous advantage possessed by the Federal command at Gettysburg which the Federal command had never previously enjoyed. The Union Army held a position, already referred to, which allowed opportunity for observation by Union leaders of most of the field and of all avenues of approach, on a large scale. Surprise, manoeuvre, and attack, such as won for the Confederates at Second Manassas and Chancellorsville, were not possible at Gettysburg. Longstreet's march to the Federal left was in view of the Union Army on the heights; he was, in fact, delayed during his march in an effort to deflect the column so it could not be seen from the Federal Signal Station. Sickles saw the Confederate line advancing to attack him. Pickett's assault on the center, on the third day, was in plain view of a large part of the Federal line, except during the few minutes that it halted in the depression, about half a mile from the Federal works, to reform. Contrast these conditions with the obscure movements of Jackson and Longstreet before and during Second Manassas; with the secret massing of Jackson's command on the Federal Right at Chancellorsville, and the sudden bursting of his assault upon the unsuspecting 11th Corps.

After the third day at Gettysburg, Meade attempted no counterstroke; both armies remained quiet on the 4th, and Meade attempted no attack, made no move to intercept Lee's retreat, no serious effort to reach his trains. On the night of the 4th, the Confederate Army retreated, and was followed very cautiously.

The Comte de Paris, in his discussion of this battle, makes this analysis:

"Meade dare not hazard a great movement, which alone could prove effective. Being but recently placed in command, he does not possess self-reliance enough to risk a great deal in order to gain a great deal."

Casting about for a situation to compare with that of the Armies after Gettysburg, I have made what may seem a strange choice. My example is the French and Russian campaign beginning with Napoleon's retreat from Moscow to Smolensk, in October, 1812, and the battle of Maloyaroslavets, before cold weather had arrived, while the French army was still an organized fighting force; while it still had food, artillery, ample ammunition, and enough horses to assure mobility; and before Napoleon had recognized that defeat, and possibly destruction, awaited him.

Those familiar with Napoleon's plan will remember that it was to move on the southerly route through Kaluga. The southerly route had not been traversed by as many troops as the direct route from Moscow to Smolensk, and the country, therefore, afforded more forage and food. Because of the impression made upon Napoleon by the Russian fighting at Maloyaroslavets, and his unwillingness to encounter Kutuzov's army in a further battle, he retired toward the North, and took the direct road. This decision ruined his army.

It will also be remembered that the French fight at Maloyaroslavets, plus the prestige of the great French leader, so impressed Kutuzov that he drew off to one side, and thereafter never threw himself directly into the path of the French army. Kutuzov has been criticised freely for his deliberate pursuit, and his persistent refusal to assail the French forces, and yet he did more fighting, and showed more initiative, than the Federal commander after Gettysburg. The fact about Kutuzov seems to be that the genius of his great opponent dominated his mind, and stimulated his imagination.

In Meade, after Gettysburg, we encounter precisely the state of mind which dictated the timid course of Kutuzov —the fear that some entirely unexpected counter-stroke which comported with the genius of his opponent would be made; an unwillingness to accept the dictates of reason and common sense; reading into the considerations to be weighed some imaginary, almost fantastic, possibility. Reason and common sense argued that after heavy losses of men, expenditure of ammunition that could not be replaced, the embarrassment of caring for thousands of wounded and of prisoners, and vast trains in an enemy country, with a great and possibly an unfordable river to be crossed, Lee was susceptible of profitable attack by the Union Army, and even in danger of ruin. Memory and imagination pictured the false sense of security of the Union leaders before the Seven Days, Second Manassas and Chancellorsville, and the unexpected and almost fatal strokes planned and delieverd by Lee on those occasions. Common sense was not strong enough to emphasize the weight which should be given to the changed conditions. Before the Seven Days, Lee's army gathered strength materially from proximity to its base, and morally from its determination to defend its capital and its homeland; before Second Manassas it enjoyed these advantages, plus the prestige of its recent successful campaign, and the leadership of Lee's greatest lieutenant, Jackson, now lost forever. After Gettysburg, all the ad-

vantages cited as possessions of the Confederates in the three preceding campaigns had passed to the Union force. It is true Meade had just assumed command of the army; but so had Lee at the beginning of the Seven Days. We must recognize the terrible losses of men and officers in the Union Army, and the influence of fatigue and reaction from great responsibilities borne by the Union commanders; we must acknowledge our possession of knowledge gained after the event, and now read into our conclusions; we may even apologize for our complacency in forming an adverse judgment against men so devoted and so harassed as the Union leaders in this campaign; and, then, after all this, we must still conclude that Meade failed to attain the first rank of military greatness when he ventured no counterstroke against the Confederate right at end of the third day, and when he neglected to put vigor into the pursuit, and permitted Lee to regain Virginia without another battle. The Grant of 1864 would not so have missed his chance, and certainly the Sheridan of 1865 would not have done so.

General Meade did not entertain the conviction which supported Grant during the terrible campaign of 1864 and 1865—that Lee's army was the objective, and that to close with it and hold on until it was fought out was the surest and least costly method of winning the war.

Lincoln's unforwarded letter shows that he had a better general view of the situation than the commanders who were close enough to it to be confused by details. He believed Lee could not recuperate from his losses of men and material as rapidly as Meade. In this clearly he was right. Therefore, on Lincoln's theory, hammering that resulted in equal losses must eventually ruin Lee. His argument was that if Meade's army could not beat Lee north of the Potomac, hundreds of miles from his supplies, in an enemy country, deficient in ammunition, beyond the reach of reinforcements, Meade could not expect to better the situation by shortening Lee's line of communication while he lengthened his own, and by subtracting from Lee various disadvantages in order to add them to his own.

Meade may have reasoned that Lee's troops, while temporarily unfitted for attack, were too seasoned and of too solid temper not to make fierce resistance to assault. He realized, of course, that the terrific but successful action he had just conducted had saved his home city of Philadelphia, his state and the entire North from dire peril. In the reaction, from the great anxiety he had borne since the hour of his appointment to the chief command, he may have shared the thought of the Greek tragedian, Aeschylus, who, we will remember, was also a soldier:

> "Let none
> Raising his heart above the things he hath
> In passionate love for plans unrealized
> Make shipwreck of great fortune."

But, by whatever route he arrived at his decision to act cautiously, General Meade lost one of the great opportunities of the War when he failed to assault the Confederates, or attempt to intercept their retreat by a serious move, after Gettysburg. We can explain his inaction; we can understand it; we may even sympathize with his state of mind and his decision; but we cannot escape the conclusion that a great chance—the greatest of his fine career—was lost.

Bibliography

Recollections of a Confederate Staff Officer.....Sorrell.
History of the Civil War in America.....Comte de Paris.
The Military Genius of Abraham Lincoln.....Ballard.
Military Memoirs of a Confederate.....Alexander.
The Battle of Franklin.....Cox.
The Retreat from Pulaski to Nashville.....Schofield.
General Lee—1861-1865.....Taylor.
Manassas to Appomattox.....Longstreet.
Advance and Retreat.....Hood.
McClellan's Own Story.....McClellan.
History of the Civil War.....Rhodes.
Bull Run, Its Strategy and Tactics.....Johnston.
Braxton Bragg.....Seitz.
Battle of Gettysburg.....Young.
Military Reminiscences of the Civil War.....Cox.
Reminiscences of the Civil War.....Gordon.
Robert E. Lee.....Page.
Memoirs.....Sheridan.
Memoirs.....Grant.
Napoleon's Russian Campaign.....Foord.
Robt. E. Lee—The Soldier.....Maurice.

"Ordnance Problem is the Crux of Our National Defense"—

Charles M. Schwab Tells West Point Cadets During Engineering Societies' Visit

BECAUSE The manufacture of ordnance is fast becoming a lost art insofar as civilian industry is concerned, ordnance is the crux of the whole question of National Defense, was the message of Charles M. Schwab, chairman of the Bethlehem Steel Corporation and President of the American Society of Mechanical Engineers, in an address to the United States Corps of Cadets at the Military Academy, West Point, New York, on May 14, 1927. The great industrialist told his hearers that our program of National Defense is critically out of balance and urged the future generals of our Army to give their thought and energy to a solution of the Ordnance problem.

Led by Mr. Schwab and Hon. Benedict Crowell, President of the Army Ordnance Association and Director of Munitions during the World War, more than a thousand engineers, industrialists and their friends visited the Military Academy and were the guests of Brig. Gen. Mereh B. Stewart, superintendent of that institution.

With Mr. Schwab on the bridge of the *Alexander Hamilton* as the boat made its way up the Hudson from New York City to West Point, the officers and men of the Atlantic Fleet, at anchor in the Hudson, paid a splendid tribute to the former Chairman of the Emergency Fleet Corporation for his outstanding service during the World War. As each naval vessel was passed the crew, with band playing, stood at attention.

At the Military Academy the officers, faculty and cadets presented a day full of interesting demonstrations closing with the world-famed dress parade at sundown.

Mr. Schwab's Address

Mr. Schwab's address, which was delivered only in part, later being released to the press in the form of an interview during the trip back to New York by boat, follows:

"It is a very great honor to be invited to address you. The Corps of Cadets, comprising in its membership representative young men from every state in the Union, is a cross-section of our finest young manhood. I am glad to have this opportunity to thank you, on behalf of the engineers, chemists and industrialists who have been your guests today, for an interesting and enjoyable visit. We trust that our coming here has not meant additional work for you, because we know your normal schedule is a pretty heavy one. Anyway, we want you to know that you have made many new friends for West Point by your conduct and bearing today.

"We honor the Corps of Cadets, as a century-old institution, for the important contributions it has made in the past in furnishing great military leaders when America has been faced with critical problems. We honor you as today's membership of the Corps of Cadets, not only because you have attained certain standards of scholarship, physique and conduct, but because we are certain that, from among you cadets of today, America will find the great military leader who will defend the Nation's sovereignty in the future, as your predecessors in arms, Grant and Pershing, have done in the past. We have come here today not merely to witness the always interesting drills and sports, nor to enjoy the most inspiring military ceremony in America—Evening Parade at West Point—rather, we have come to evince our interest as engineers, chemists and manufacturers in the vitally important subject of National Defense; to pay our respects to you young gentlemen to whom will be entrusted, in the natural course of events, very grave responsibilities. We have come to tell you that we have every confidence that you will measure up to the high standard established by West Pointers in times of national peril during the one hundred and twenty-five years of the existence of the Military Academy.

"You young gentlemen are receiving splendid training in the *use* of arms, and if you stay in the Army, the great majority of you will devote the best part of your lives to training the reserve manpower of the nation in the *use* of arms. Now, there is one thought that I want to leave with you and that is this: In times past, we Americans have been all too ready to assume that preparation for a possible national emergency consisted almost entirely of planning for the mobilization of manpower, forgetting the fundamental fact that men without rifles or field guns and the necessary ammunition, are not soldiers.

Men Easier to Obtain Than Munitions

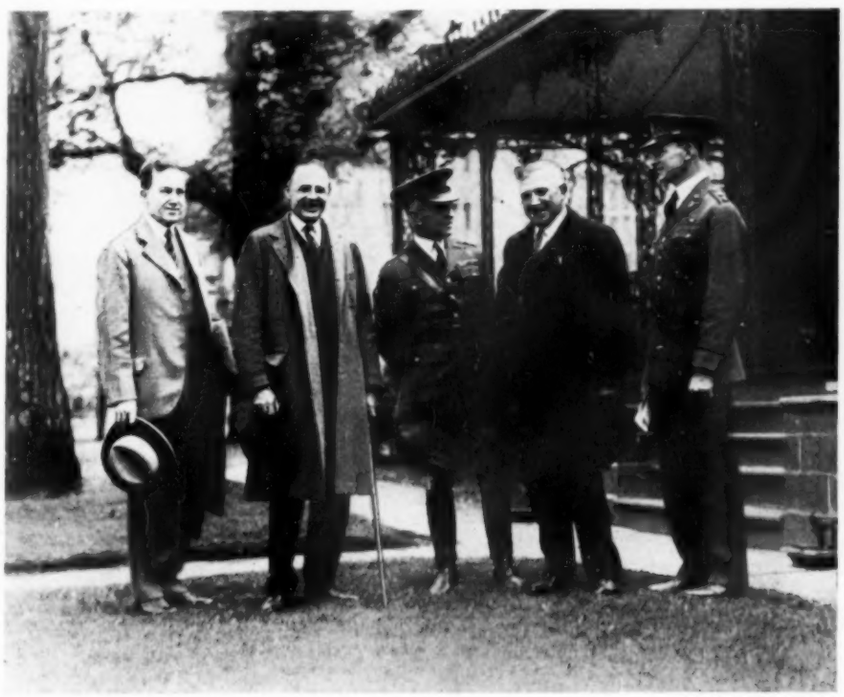
"If there was one great lesson that stood out above all others as a result of our experience during the World War, it was the demonstrated fact that relying solely upon our own resources, we could call to the Colors, organize into units and train our citizenry at a rate which far surpassed any possible rate at which we could equip them with the necessary ordnance.

"I am inclined to think that this condition will always obtain in America; namely, that the supply of ordnance will be the critical factor in any program for national defense and, as you young gentlemen are some day destined to be entrusted with making proper decisions which have a vitally important bearing upon our continued existence as a nation, I want to set you thinking upon a phase of national defense which, in my opinion, the military mind has too often been apt to dismiss as being of relatively little importance.

"You all know that we are living in an age when machine power is to a greater and greater extent, supplanting manpower. We have developed machinery not only for

manufacturing purposes, but for lightening the burdens of housekeeping and for purposes of recreation and enjoyment. This is a Machine Age and, unfortunately, the same underlying factors are working to place warfare to a greater extent, on a machine basis. In the Spanish American War, we had perhaps a half dozen machine-guns as the total equipment of all our Army in Cuba. At the outbreak of the World War, we had increased the use of this weapon to about a half dozen per regiment. By the time of the Armistice, we had increased the use of machine-guns by practically 2,000 per cent. Other mechanical weapons, such as tanks and railroad artillery, were developed and used in increasing quantity. The use of airplanes for military purposes was conceived and developed to a tremendous extent, all within a period of about 4 years.

"Now, it is altogether probable that the use of mechanical devices in warfare will continue to increase and the proper solution of the ordnance problem will be of even greater importance than it was during the World War. If that is so, the question that you generals of the future are going to be most concerned with is, "Where and when can we obtain ordnance?" If that question cannot be answered satisfactorily, and arms and ammunition of suitable quality and adequate quantity cannot be supplied sufficiently early in the mobilization program, all other well-laid plans will prove futile.



Leaders of the Pilgrimage to West Point

Left to right: Col. James L. Walsh, Ord. Res., Chief, New York Ordnance District; Benedict Crowell, President, Army Ordnance Association; Brig. Gen. Merch B. Stewart, U. S. A., Superintendent, United States Military Academy; Charles M. Schwab, President, American Society of Mechanical Engineers, and Maj. Earl MacFarland, Ord. Dept., U. S. A., Professor of Ordnance and Gunnery at West Point.

"It may be contended that the Army officer's job is training soldiers and mobilizing manpower, and that Industry should stand ready to provide the arms and ammunition needed to convert citizens into soldiers, but that is not in accord with conditions today. The Nation holds you military men responsible for taking all necessary measures to provide for the national defense in emergency. Industry is busily engaged in its peace-time pursuits endeavoring to meet competition in world markets. It is against the traditional policy of America to encourage a civilian munitions industry. Certainly, today it can be said that the manufacture of ordnance is fast becoming a lost art insofar as civilian industry is concerned.

Civilian Munitions Plants on Wane

"Before the World War, America possessed several large civilian manufacturing plants devoted in a greater or lesser degree to the manufacture of field artillery, ammunition, and other articles of ordnance, including among others my own plant at Bethlehem, but today the Bethlehem Steel Corporation has definitely abandoned any thought of ever again engaging in the manufacture of ordnance except in times of the gravest national emergency. All the civilians who had learned to design and manufacture cannon, armor plate, and other items of ordnance are now devoting their time to entirely different activities. In general, this same condition obtains with respect to other commercial plants engaged in the manufacture of ordnance prior to the World War. This situation places an increasingly great responsibility on the Army, one that you military leaders of the future must take into consideration. You cannot begin too young to think of war as a vast industrial undertaking.

"You are probaby wondering why I have not placed aviation material in the same category as ordnance. It is for this reason: interest in aviation and activity in the manufacture of airplanes and accessories is increasing by leaps and bounds. The problem of providing aircraft for an expanded Army is working toward ultimate solution. Exactly the opposite is the case when we consider ordnance. Fewer and fewer of our factories are able to produce rifles and ammunition.

"We have, perhaps, seventeen million physically fit men of military age; we have such Government-supported institutions as the Regular Army, the National Guard, the Organized Reserves, the Citizens Military Trainings Camps, the National Rifle Matches—organized to train manpower in the *use* of arms, presumably on the assumption that the necessary arms and ammunition will be ready in the quantities and at the times needed during mobilization. But the truth of the matter is that we are doing relatively little to educate Industry in the manufacture of arms. To the business man sizing up the whole problem of National Defense, it sometimes appears as if too many regular army

officers are assigned to duties in connection with the mobilization and training of manpower for use in the event of emergency, and entirely too few officers are assigned to activities leading toward the soluton of a far greater problem, the mobilization of industry to provide the necessary arms and ammunition for an expanded army.

"Now, you all know that it is easier to learn to drive an automobile than it is to learn how to make one. By the same token, it is easier to teach a man how to shoot a rifle than it is to teach a mechanic how to make it. Incidentally, the rifle has to be manufactured before it can be used. So, I would like to raise the question in your own minds, as to whether we are not unduly emphasizing the man-power problem at the expense of the munition-power problem.

"We accomplish such wonderful things in America in the way of mass production that we sometimes lose sight of the great amount of preliminary work that must be done, and the great length of time which must necessarily elapse, before mass production can be attained. We hear of some great automobile factory turning out a complete automobile ready to run under its own power, at the rate of one every minute or so during the day. We lose sight of the fact that, perhaps, two solid years of preparatory effort have been required to design jigs and fixtures, to determine the most effective layout of machinery, to design special purpose machinery, to recruit and train the employees into a smooth-working unit. All of these things have to be done before even a single car comes off the assembly line. Even then, we are apt to find that some of our calculations have been in error; that some of the parts do not go together as smoothly as we could wish. So, there is a period of readjustment, re-routing and general tuning up before we attain the huge production which amazes the casual visitor.

"In considering National Defense, it is apparent that the peace-time life of a nation keeps alive and increases the knowledge necessary to the organization and employment of an expanded army with two vital exceptions: Training in the *use* of arms, and education in the *manufacture* of arms.

"Under great handicaps, our Army has, in the past, kept alive the necessary knowledge in regard to the *use* of arms. If present conditions obtain in the future, our Army will also be faced with the problem of keeping alive the necessary knowledge involved in the *manufacture* of arms, and you young gentlemen of the Military Academy, while your minds are open to new impressions and new ideas, must undertake the job of making the Army munition-power minded as well as man-power minded.

"The engineers, chemists and manufacturers of America stand ready to work with the Army in preparing for National Defense. Industry understands perfectly well how to feed, clothe, transport, shelter and provide communications for the largest army we could possibly organize, because Industry now has and is expanding its knowledge of these activities common to both our peace-time and war-time pursuits. The medical, surgical and dental professions can provide all necessary care and attention because they are being automatically schooled in peacetime for their war-time duties. But, Industry does not and cannot as a result of its peace-time activities, keep alive the knowledge necessary to the production of ordnance in the quantities demanded by an expanded army, in order to give it at least an even break with the enemy.

Ordnance—The Crux of the Problem

"There you have the crux of the whole question of National Defense—namely, the Ordnance problem. You may ask, "What can be done towards its solution?" The one and only thing we can do in times of peace is to have more knowledge of ordnance manufacture promptly available at the outbreak of war, and the only way we see to bring about this condition, is to have more trained Ordnance officers available in emergency. I have been told that there are sixty Regular Army officers in New York City alone, assigned to teach National Guard and Organized Reserve units the elements of military science and tactics—in other words, the *use* of arms. The hundreds of plants in the metropolitan area which would be called upon to manufacture ordnance in emergency, and which now stand ready to work with the Army in making plans to that end, have but one Regular Army Officer to whom they can turn for necessary information.

"Under present-day conditions, we must have a far greater proportion of our officers take their training at the various arsenals, where the art of ordnance manufacture is kept alive on a laboratory basis so that they, in turn, can be detailed to duty at various commercial manufacturing plants for the purpose of assisting manufacturers in assembling the vast amount of preliminary data in the shape of drawings for tools and jigs and fixtures; design of working gages; computation of schedules for raw materials, semi-finished components, additional equipment; the layout of highly specialized machinery, and estimate on additional power requirements. It is in this way, and in this way only, that we can hope to shorten the gap between the declaration of war and the date when our unlimited manpower will be adequately armed and supplied with the increasingly great quantities of ammunition which modern warfare demands.

"Do not let the lesson of the World War be obscured by the fact that our own deficiencies in Ordnance production were offset by the generous offers of the Allies. If we are obliged to rely upon our own efforts alone, as will probably be the case in any future emergency, our failure to recognize the paramount importance of the ordnance problem will result in national disaster. What we need is a completely balanced program for National Defense with the Army paying proper attention to munitionpower as well as manpower. Rifles without men to use them, would be a needless waste of money; but men without rifles, would involve a ghastly sacrifice of thousands of brave young lives.

"As conditions are today, our program of National Defense is critically out of balance. We look to you military leaders of tomorrow to give your thought and bend your energies to the solution of the Ordnance problem—the crux of National Defense."

In addition to the American Society of Mechanical Engineers and the Army Ordnance Association, the following organizations participated in the visit to West Point: American Chemical Society, American Electrochemical Society, American Engineering Council, and the American Institute of Chemical Engineers.

Bombs and Bomb Fuzes

Lieut. W. E. Becker, Ord. Dept., U. S. A.*

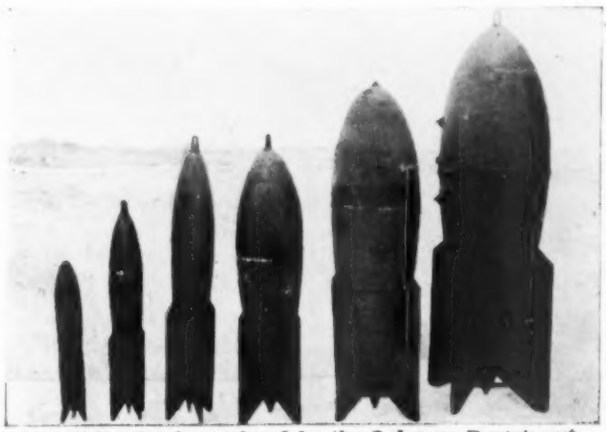
BOMBING and machine gunnery represent the two general means of attack from aircraft in modern day warfare. Up to this time bombs have been intended primarily for use against land and water targets, while machine guns have been used in combat between aircraft as well as against personnel on the ground. The indications are that a requirement will shortly exist for bombs with special types of supersensitive and time fuzes for use in strictly aerial combat. It was found recently in bombing practice at Langley Field that our obsolescent wartime 25-lb. fragmentation bomb with its fuze, designed for use against personnel on the ground, could be used effectively in bringing down a captive balloon. By dropping these bombs from pursuit planes in steep dives approaching the vertical, the impact with the balloon fabric proved sufficient to function the nose fuze and to give practically an instantaneous detonation. These tests open up new possibilities for attack from fast pursuit planes on dirigibles, large balloons and formations of heavy bombing planes.

Progress in bomb design is dependent to a large measure on the development of new tactics by the Air Corps, as well as on the changes made in the defense of the usual land and water targets against bombs. Special types of targets require special bombs and bomb fuzes with definite characteristics. Two important classes of aircraft bombs, as developed and manufactured by the Ordnance Department, are (a) demolition and (b) fragmentation.

Demolition bombs will be discussed first and in detail, since these represent our most important class. Only a brief discussion of the fragmentation bombs will be undertaken.

Demolition Bombs

Demolition bombs can be classified with regard to type of body construction and thickness of wall as thin case and thick case. They can be further classified with regard to shape of body as streamline body type and cylindrical body type. It is believed that the reasons for our present designs can be better appreciated, if the various types of demolition bombs developed in the past are discussed with reference to their weaknesses and to the steps taken to correct such weaknesses.



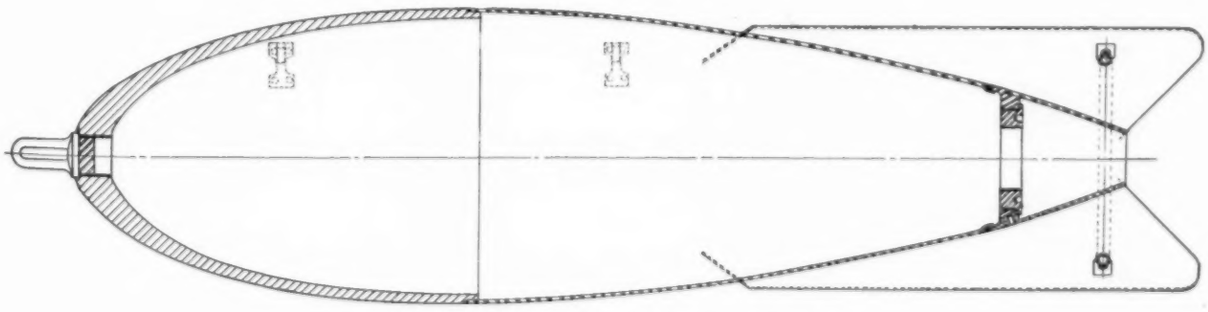
Demolition Bombs produced by the Ordnance Department during the World War.

Aircraft bombs were first used during the World War, and due to the fact that the initial development and experimental work was carried on under the pressure of wartime necessity for quick production, they, in many cases, failed to meet the strength and other requirements as recognized today. In July, 1917, samples of the French Andreau type of thin case demolition bombs, which were being used in large quantities by the French at that time, were brought to this country. These were adopted as models for our development work and the design of three sizes undertaken which were finally known as the demolition bombs, 25-, 50- and 100-lb. Mk. I. The cases or bodies were made entirely of pressed steel sections joined with circumferential and longitudinal welds, the nose sections being thicker than the rear. Soon after these first three sizes were completed, development of larger sizes, known finally as the demolition bombs, 300-, 600-, and 1,100-lb. Mk. I, was started.

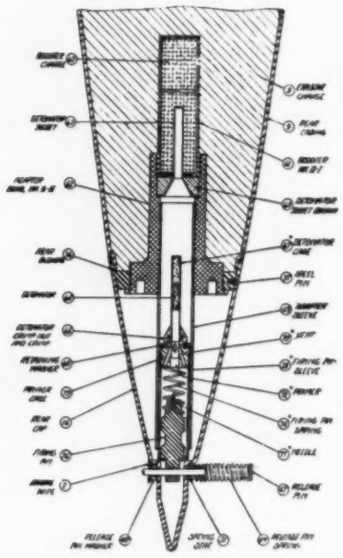
The bodies of these larger bombs have cast steel noses with rear portions of pressed steel made up of sections joined by circumferential and longitudinal welds. The proportion of explosive to total weight in the Mk. I type of bomb varies from 50 per cent. to 58 per cent. in the several sizes.

These Mk. I bombs carry a tail fuze *only* which was developed in two types. The first is known as the Bar-

*Lieutenant Becker is in charge of the Bomb Section, Ammunition Division, Office of the Chief of Ordnance, Washington, D. C.



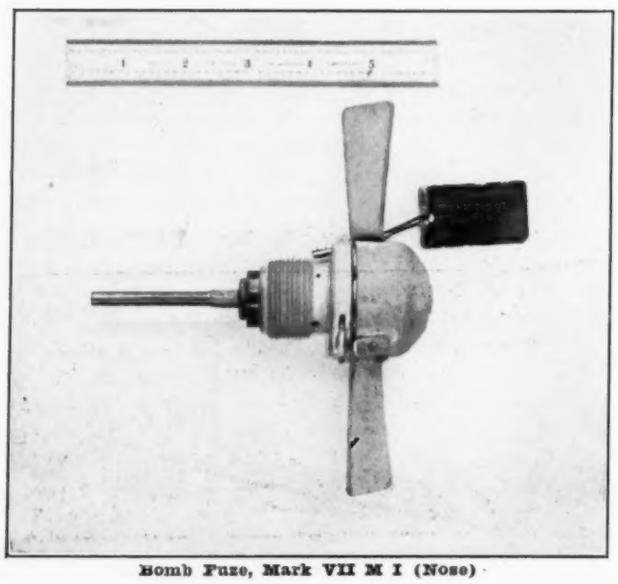
Cross Section of 300-lb. Demolition Bomb, Mark I.



Bomb Fuze, Mark III (Tail).

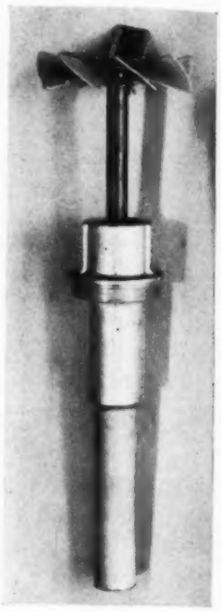
low type, or bomb fuze, Mk. I. The primer detonator assembly is held at one end of a tube by means of a release pin. An arming wire connected with the arming mechanism of the bomb rack serves to hold this release pin in place against the action of a spring under compression. If it is desired to drop the bomb to detonate on impact, the arming wire is held in the arming mechanism during release and the weight of the falling bomb is sufficient to cause the arming wire to pull out of the fuze. The spring then ejects the arming pin and the primer detonator is allowed to float down the fuze tube on an air cushion, while the bomb is in flight, and rest lightly upon a firing pin at the bottom of the tube. On impact, inertia causes the firing pin to fire the primer, which starts the detonation of the explosive train through the detonator to the annular booster and thence to the main explosive charge of the bomb.

If it is desired for any reason to drop the bomb "safe," that is, so it will not function on impact, the arming wire is allowed to drop with the bomb, and as a result, the release pin continues definitely to hold the primer detonator in the upper end of the fuze tube, and on impact no detonation occurs. This fuze does not have a booster of sufficient size to give dependable functioning. No delay action can be obtained except a small inherent delay due to the fact that it is an inertia type fuze. It is armed and capable of functioning on impact as soon as the bomb is released from the plane. For this reason, in case the bomb is accidently released before the plane leaves the ground or at an extremely low altitude, there is grave danger of serious accident. The fuze is not dependable on water impact. Its use has resulted in a large percentage of duds on land.



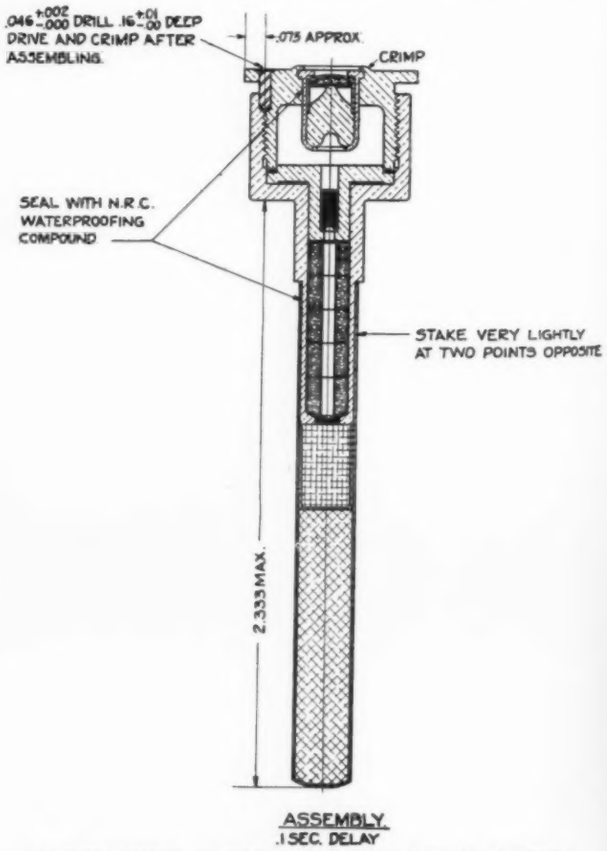
Bomb Fuze, Mark VII M I (Nose)

The second type of tail fuze developed for the Mk. I series of demolition bombs was designated as the Ragsdale, or Mk. III, type. This has a larger booster than the Mk. I type, offers opportunity for a slightly delayed action through the use of a delay element in the primer detonator, but was found unsatisfactory due to the fact that it also armed the instant it left the plane and was even more susceptible to accident if the bomb was dropped accidently before the plane left the ground.



Bomb Fuze, Mark V MI (Tail).

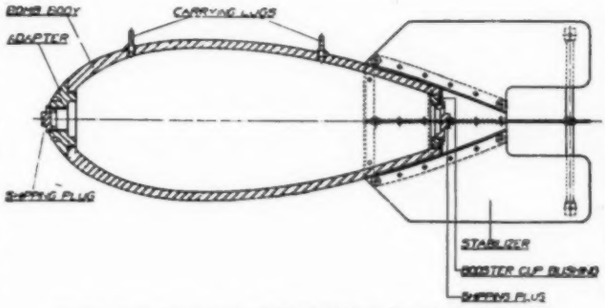
The Mk. I series of demolition bombs proved generally unsatisfactory. Their bodies or cases, were not of sufficient strength, due largely to the numerous welded joints. The stabilizing fins were not stiff enough to prevent wobbling in flight. The fins had to be removed on the field in order to insert the tail fuze. A cablegram from



A Late Design of Primer Detonator for Bomb Fuzes.

the A. E. F. in July, 1918, first outlined the necessity for delayed action in bomb fuzes.

After the Armistice a modification of the Mk. I series was undertaken with a view to eliminating, insofar as possible, the unsatisfactory functioning that had been experienced. The 25- and 50-lb. sizes were declared obsolete due to their small capacity and these were not considered in the modifications. All of the other sizes were provided with newly designed fuzes for both nose and tail, together with new boosters and detonating arrangements.



Body Arrangement of Demolition Bombs, Mark II (Thick case type).

The final design of nose fuze adopted was known as the Mk. VII MI. It is of arming vane type and requires a rotation of the arming vanes a definite number of turns to arm. An arming wire is provided for use with this fuze so that, if desired, the bomb can be released safe.

The final design of tail fuze adopted is known as the Mk V MI type. This fuze is equipped with arming vanes which prevent it from arming within a definite distance from the plane. It has been considered necessary since the War to provide demolition bombs with both nose and tail fuzes for certainty of action. Considering the wartime life of a bombing plane and the hazards incident to delivering a load of bombs over the enemy, it is considered wise economy to spend a few extra dollars in providing both nose and tail fuzes. These fuzes are purely mechanical firing mechanisms and carry no detonating elements within their assemblies. Primer detonators are designed as separate assemblies and are assembled to the fuzes before same are screwed into the bomb. This arrangement allows for the use of anyone of several delays.

Wartime experience indicated that demolition bombs are required for use primarily against unprotected structures or targets such as fortifications, bridges, canals, power plants, etc. In order to obtain the maximum destructive effect on this type of target a short delay fuze action has been found necessary. This allows a bomb of proper strength to penetrate the target before detonation takes place and gives a maximum heaving or lifting effect. It was realized during the War that our Mk. I bombs were weak and that greater body strength was necesary in order that the bodies could withstand greater forces of impact. It was considered that demolition bombs are also required for use with a long delay fuze action against targets such as submerged submarines, water, gas and sewerage systems, major fortifications, etc.; and also that for the smaller sizes of demolition bombs, a requirement for instantaneous fuze action exists for use against targets such as ammunition dumps, depots, frame structures, machine shops, etc.

As to the proper ratio of weight of metal to weight of explosive in demolition bombs, conflicting arguments have been advanced. It has been contended on the one hand that the power of an explosive is increased by the confinement, and that for demolition effect above ground and on unprotected structures, the blast alone is ineffective as compared with blast effect plus fragments, since fragments carry destruction to greater distances. The opposing view has been that demolition bombs should be designed primarily for detonation below the surface of the target, and that as a result explosive only can be considered as the active part of the bomb and, therefore, the greater the amount of explosive and the less the amount of metal, the more effective the bomb, provided of course the bomb is strong enough to withstand the forces of impact. Both of these arguments have been considered logical within certain limits. It was decided shortly after the Armistice to determine the required design of demolition bomb body by developing first a new type of thin case bomb, which would avoid the structural weaknesses of the wartime Mk. I type, but which would have only sufficient metal in the body to give the necessary strength for the penetra-

Hard Surface used to test penetrating effect of bombs dropped from aircraft, Aberdeen Proving Ground.

Demolition Bomb, 600-lb. Mark I, after impact on hard surf ace—dropped from altitude of 3,000 feet.

tion of unprotected structures, and carry the maximum possible explosive content; and second, a series of thick case demolition bombs to give effective fragments along with blast action and have the required strength.

The *thin* case bombs as designed are known as the demolition bombs, 100-, 300-, 600- and 1,100-lb. Mk. III. They carry both nose and tail fuzes of the arming vane type. The 100-lb. size is built up with deep drawn nose and rear body sections joined together with circumferential welds. No longitudinal welds are used. The 300-, 600- and 1,100-lb. sizes are designed with cast steel noses and deep drawn rear body sections joined together with circumferential welds. The fin assemblies are designed as units, capable of easy assembly in the field, and do not require removal from the bomb body in the fuzing procedure. The fin surfaces are held in a rigid assembly by braces. The Mk. III type bombs carry an explosive content of approximately 55 per cent. of the total weight.

Thick case bombs were designed in three sizes and were finally designated as the demolition bombs, 100-, 300-, and 600-lb. Mk. II. It was planned to manufacture the bodies of these bombs in four different metals, steel, cast iron, malleable iron and cast steel, and with an explosive content of approximately 34 per cent. These were identical with the newly designed Mk. III series as regards fuzing arrangements and fin assemblies. The new designs of the Mk. II and Mk. III bombs had been laid down and considered by the summer of 1919.

A bomb board was convened during the fall of 1919 to study the results obtained with bombs of wartime manufacture, both our own and those of foreign countries; to consider the development work started after the signing of the Armistice; and to make recommendations on the development procedure to be followed in the future. The board approved the designs of thin and thick case bombs that had been undertaken after the Armistice, and recommended that bombs of the thin case type weighing 2,000 and 3,000 lbs. be developed in addition. The explosive content recommended for the thin case type was from 50 to 60 per cent. of the total weight provided sufficient strength of metal parts could be ob-

Demolition Bomb, 300-lb. Mark II, after impact on hard surface—dropped from altitude of 4,000 feet.

Demolition Bomb, 600-lb. Mark II (Malleable Iron) after impact on hard surface—dropped from altitude of 2,000 feet.

tained to allow penetration of unprotected targets. For the thick case type no specific explosive content was mentioned, but it was recommended that such be made as great as possible, consistent with the thickness of metal necessary to result in satisfactory fragmentation effect. The board also recognized the need for short and long delay fuze action. It was considered that the short delay would be the fuze action used most with demolition bombs from a tactical standpoint.

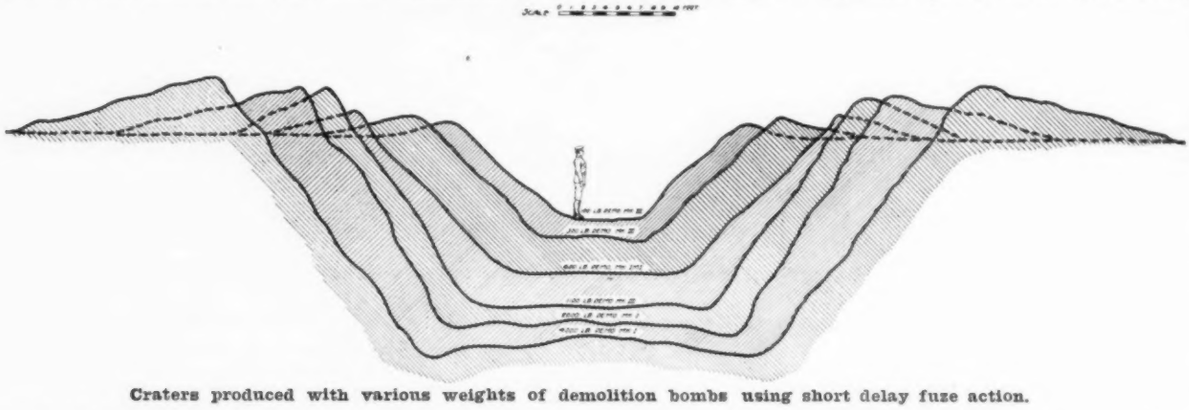
The board recommended further that a standard hard surface be constructed at the Aberdeen Proving Ground, consisting of one foot of concrete, not reinforced, over two feet of crushed rock, on which bombs could be dropped for strength of body test. It was considered that a bomb dropped on this hard surface from altitudes sufficient to allow penetration of the maximum diameter of the body would result in forces of impact comparable with those encountered by the bombs when dropped on the type of unprotected targets for which demolition bombs are intended. In conducting these tests the bombs are inert loaded to weight with sand.

As a result of these recommendations, experimental lots of the several weights of the Mk. III thin case type and Mk. II thick case type demolition bombs were manufactured. Hard surface strength tests were conducted with these as well as with the Mk. I wartime type. The Mk. I bombs all failed to pass the hard surface test, due to failure of the welded joints and, in the case of the larger bombs, to failure of the nose castings. The Mk. III 100-, 300-, 600- and 1,100-lb. bombs passed the test satisfactorily. Some difficulty was experienced with the original design of the 100-lb. Mk. III bomb due to a weak nose section which was non-uniform as a result of the drawing process. This was redesigned and the bomb finally passed the hard surface test satisfactorily. The Mk. II thick case series, 100-, 300- and 600-lb. bombs passed the hard surface test with the cast steel body. The malleable iron, cast iron and semisteel of the 300- and 600-lb. bombs failed. The malleable iron and the cast iron bodies of the 100-lb. bomb failed but the semisteel stood up.

From these hard surface tests considerable data rela-

Fragments of Demolition Bomb, 600-lb. Mark II (Cast Iron) after impact on hard surface—dropped from altitude of 2,000 feet.

tive to strength requirements for bomb bodies were obtained. Knowing the physical dimensions and weight of a bomb and the kind of metal making up the body, a formula is available by which the so-called "set-back ratio" can be calculated. This set-back figure is the ratio of the maximum force of impact which the bomb can theoretically withstand to the weight of the bomb. If we calculate by means of this formula the "set-back ratio" for bombs of various types and weights tested on the standard hard surface and plot these calculations against weight of bomb and then pass a curve through these points separating the bombs that have failed from those that have passed, we obtain the required relation between "set-back ratio" and weight of bomb necessary, in order that the bomb will meet the strength requirements that have been decided upon. All demolition bombs are now designed in accordance with this relation. A suitable factor of safety is applied in addition.



Craters produced with various weights of demolition bombs using short delay fuze action.

Other proving ground tests were laid down by the Bomb Board with which the demolition efficiency of bombs can be determined. One of these is a crater test in which the loaded bomb is dropped with short delay fuze setting on normal ground. From the dimensions of the crater the demolition efficiency is in part determined. The size of the crater indicates the power of the bomb in terms of lifting or heaving effect. Also, in this test the measured length of delay and functioning after impact determines the proper action of the fuze and detonating trains. The crater as measured does not represent the actual amount of earth lifted because much of that falls back into the crater. The diameter of the average crater in the sandy loam at Aberdeen Proving Ground is in feet approximately five times the cube root of the weight of explosive in pounds.

High panels used to test demolition effect of bombs at Aberdeen Proving Ground.

Another test in determining the efficiency of demolition bombs is conducted in the high panels and gives an indication of the fragmentation and blast effect. Upright panels are placed around the bomb at distances of 50 and 75 feet for the purpose of determining the number and perforating power of the fragments. Blast meters are secured to curved supports. The bomb is detonated statically in a vertical position on a piece of armor plate at the center of the panels. This test furnishes comparative data for various types of bombs, but is not entirely satisfactory.

A more practical test of the destructive effect of demolition bombs is obtained by the static detonation of bombs within or near buildings of permanent construction. Unfortunately buildings of the desired sort are not available in the required numbers. A test of this kind was, however, conducted at the proving ground. Thick case 100 kilo. bombs which the French produced in July, 1918, after eight months of experimental work, and our own thin case 300-lb. Mk. III bombs were detonated at distances of 75, 50 and 25 feet from the walls of a substantial brick house, alternately on opposite sides. Several fragments from the 100 kilo. thick case bomb penetrated the brick walls and also stripped off some of the roof, cracked plastering, etc. The fragments from our 300 lb. Mk. III bomb peppered the walls but none penetrated. This bomb did more damage internally, however, than did the thick case French bomb. It moved partition walls, lifted roof rafters and wrecked the fireplace arch and other brick work. The wall thickness of the 100 kilo. bomb was designed for fragmentation effect rather than for strength and the body carried 43 per cent. of the total weight in explosive charge. The metal in the 300-lb. thin case bomb is distributed for strength rather than for fragmentation effect and was designed for as high an explosive content as possible consistent with the strength requirements of 52 per cent. of the total weight. Various conclusions can be drawn from these tests as to the advantages of thick case bombs over thin case and vice versa for this

class of demolition work, but there appears to be a slight advantage on the side of the 300-lb. Mk. III thin case bomb. The 100 kilo. bomb compares favorably as to arrangement of metal with our Mk. II thick case series.

Upon the completion of the hard surface, crater and functioning tests at the proving ground with the Mk. II thick case series and the Mk. III thin case series, it was generally concluded that any slight advantage that might be represented in the thick case series did not warrant the standardization of the two types. As a result, the 100-, 300-, 600- and 1,100-lb. Mk. III thin case bombs with approximately 55 per cent. explosive content and with metal arrangement to resist definite forces of impact rather than for fragmentation effect, are our standards for manufacture today.

In 1921 the design of a 2,000-lb. demolition bomb was started and was based in general on the British 1,600-lb. bomb, but was made considerably stronger through the use of seamless steel tubing in place of a riveted drum used by the British for the cylindrical body. This initial design of our 2,000-lb. Mk. I bomb had a cast steel nose riveted and welded, and a cast rear cap welded, to the cylindrical body. It carried nose and tail fuzes and detonating trains similar in principle to those used in the standard type of streamline bodied bombs. The explosive content was 49 per cent. of the total weight. Proving ground tests were conducted on July 18, 1921, and the battleship *Ostfriesland* was sunk with one of these on July 21 of the same year, or 115 working days after the first experimental order was placed. This bomb proved to be generally satisfactory but several changes had been found advantageous in arriving at our present standard 2,000-lb. Mk. I MII bomb. The first change was to attach the rear cap to the cylindrical body by means of a large screw thread rather than by welding. This facilitated and reduced the cost of loading. The second change was the elimination of the heavy nose casting and the substitution of a forged nose integral with the cylindrical body and formed by a swaging operation. This arrangement resulted in a stronger bomb, reduced the total weight 100 pounds and increased the explosive content from 49 per cent. to 52 per cent. This Mk. I MII bomb is our present standard for manufacture.

2,000-lb. Demolition Bomb, Mark I.

The bomb board recommended a 3,000-lb. bomb as the largest of the demolition series. After the board adjourned, however, experience gained in development work and tests at the proving ground indicated that this weight represented too small an increase over the 2,000-lb. size to warrant its development. The design of a 4,000-lb. bomb was started in its place. In 1921 the demolition bomb, 4,000 lb., Mk. I, similar in arrangement of metal parts and fuzing to the 2,000-lb. Mk. I bomb, was produced. The development tests were suspended when the last available airplane equipped to carry this size of bomb crashed and was completely wrecked in June, 1922.

The Air Corps has practically completed the development of a heavy bomber known as the HB I, which will carry this 4,000-lb. bomb to the tactical ceiling. One of these planes is to be sent to the proving ground in the near future and will be used to complete the tests. So far as is known, this bomb represents the largest that has been produced by any country.

The experience gained in manufacturing, loading and handling the 2,000-lb. and 4,000-lb. bombs has indicated the cylindrical type of body to be superior to the streamline type. The advantages are as follows:

(a) Economy in production of bodies in that facilities of the tube and pipe industry can be utilized in the event of an emergency.

(b) Greater strength due to the absence of seams, welded joints and steel nose castings.

(c) Number of drawing operations reduced which decreases cost.

(d) Considerable increase in percentage of explosive can be obtained.

(e) Loading operations cheapened and facilitated.

(f) Easier to maneuver in the field.

(g) Results in satisfactory flight and ballistic characteristics.

To determine definitely the maximum explosive content that can be obtained in a cylindrical body type of bomb and to what extent an increase over the usual 52 per cent. would result in increased demolition effect, an experimental 2,000-lb. bomb was designed, known as the demolition bomb 2,000-lb. E-IV. This bomb is 4½ inches greater in diameter and 26 inches shorter than the present standard Mk. I MII bomb. In striving for the maximum explosive content, it was found desirable to increase the diameter and reduce the length in this manner since roughly three quarters of the stress on the forward portion of the body during impact is due to the height of the explosive behind it. All excess metal not required for strength was machined from the walls of the cylindrical part of the body, resulting in a taper on the inner walls. An explosive content of 67 per cent. was thus obtained. The manufacturing cost of the metal parts of this bomb, however, was found to be approximately 200 per cent. of a similar cost for the standard 2,000-lb. bomb. A number have been manufactured and tests conducted. The dimensions of the craters obtained

Low panels for determining effect of fragmentation bombs.

are practically identical with those of the 2,000-lb. Mk. I MII bomb. The most practical procedure in designing cylindrical type bombs from cost considerations appears to be the use of seamless steel tubing of uniform wall thickness, which will require no machining on the cylindrical part. Considering the numerous advantages of the cylindrical type of bomb over the streamline, projects have been initiated which call for the development and standardization of 100-, 300-, 600- and 1,100-lb. cylindrical type demolition bombs. This will thus bring about a complete series of this type of bomb. The designs of the 300-, 600- and 1,100-lb. bombs have been completed, and experimental orders are now under way. The design of the 100-lb. bomb is now in progress. It is considered that this discussion of demolition bombs would be incomplete without at least a reference to the several bomb tests on naval vessels that have been conducted in the past. During the War many bombs were dropped on submarines, but no important bomb attacks on battleships appear to have been undertaken. The largest bomb used at the Dardanelles is thought to have been the British 112-lb. In 1920 a foreign demolition bomb weighing 1,600 lbs. was detonated, statically on the deck of an obsolete battleship, resting against an 8-inch gun turret. The damage was such as to arouse great interest in the possibilities of using large demolition bombs against naval vessels and served to open up a new method of attack against such targets. These tests paved the way for later tests against other naval vessels and resulted in all possible priority being given to the development and manufacture of the 2,000- and 4,000-lb. bombs. In 1921 an obsolete destroyer was sunk by direct hits with 300-lb. bombs. A cruiser was damaged by direct hits with 300-lb. bombs and was sunk by a 600-lb. bomb. A battleship was damaged by 600- and 1,100-lb. bombs striking close and was sunk by a 2,000-lb. bomb. In 1923 a battleship was sunk by an 1,100-lb. bomb which penetrated the afterdeck, blew off that deck and a portion of the side. Another battleship was sunk by an 1,100-lb. bomb which as a result of good bombing, together with luck, struck a ventilating shaft and passed through the bottom of the ship.

These tests, together with the results of more recent battleship tests, have demonstrated that our demolition bombs can put naval vessels of the first class out of commission and sink them, even though the bombs are insufficiently strong to penetrate the main protective deck of thick armor. It has also been demonstrated that a large demolition bomb with the proper delay fuze action in striking water within a limiting distance from a modern battleship, can produce sufficient damage to the unprotected bottom to put the ship definitely out of commission.

Fragmentation Bombs

This class of bombs to date has been intended primarily for use from aircraft against personnel on the ground. Two types of fragmentation bombs were developed and manufactured during the War.

The first was the fragmentation bomb, 17-lb. Mk. II, made up of rejected 3-inch and 75-mm. artillery projectiles carrying an explosive charge of approxiamtely 10 per cent. of the total weight of the bomb. Tests made with this bomb after the War indicated its efficiency as

Silhouette Field, Aberdeen Proving Ground, used in determining effect of fragmentation bombs.

regards number and size of fragments to be high when compared with other bombs developed during and since the War. However, the fuzing arrangement tended toward a slight delay in functioning and caused this bomb to be declared obsolete. It was decided that a greater weight of bomb and a quicker fuze were necessary.

The second type produced during the War was known finally as the fragmentation bomb, 25-lb. Mk. III. This was taken entirely from the British Cooper bomb, in fact a number of Cooper bombs was purchased, together with manufacturing rights during the War from Great Britain. Bombs manufactured in this country had bodies of both malleable iron and semisteel and carried from 20 per cent. to 25 per cent. explosive by weight. The sloping exterior of the body tended to give range to the fragments, which resulted from that part of the body, to the rear of the maximum cross sectional area perpendicular to the longitudinal axis. The nose fuze is designated as the Mk. XII and is of arming vane type and entirely mechanical. Large numbers of these bombs were manufactured during the War.

Relative sizes of 4,000-, 2,000-, 1,100-, 600-, 300-, and 100-lb. demolition bombs and 25-lb. fragmentation bomb.

The bomb board in 1919 recommended that studies be undertaken in connection with future development of fragmentation bombs to determine:

1. The relation between weight of explosive and weight of case to give most effective fragmentation.
2. The proper arrangement of metal parts to give uniform size of fragments.
3. Proper shape of case to give best distribution of fragments.
4. Best size of bombs for most effective action.
5. Type of metal for body to result in most effective fragmentation.

In determining the fragmentation efficiency of bombs at the proving ground, three types of tests are conducted. The pit test, the low panel test and the silhouette test. In the pit test the bomb is placed in a wooden box and buried in a sand pit of suitable size, and detonated statically. The sand is then screened and the fragments recovered on a screen of 3/8-inch mesh. They are then weighed, counted and classified. It is desirable to obtain as great a percentage of the weight of the metal parts on this 3/8-inch mesh screen as possible and have this weight made up of as great a number of fragments as possible. A fragment which is just large enough to be retained on this size of screen is considered as effective. The low panels consist of four quadrants of panels, 12 inches wide, 5 3/4 feet high and 7/8 inch thick, of spruce lumber. Each panel represents the height and width of a man. Quadrants of panels are placed 10, 20, 30 and 40 meters from the center at which the bomb is fragmented statically. By substituting either the total number of perforations counted or the number of panels perforated at the several distances in a formula, a figure is obtained which represents relative fragmentation effectiveness in terms of casualties over a definite area and with a definite and uniform distribution of personnel over this area.

The silhouette test consists in dropping a bomb on a field of silhouettes spaced 15 by 45 feet apart. The silhouettes are of the same dimensions as the low panels and represent the height and width of a man. The bombs are dropped from altitudes between 2,000 and 4,000 feet. The perforations of silhouettes within radii of 10, 20, 30 and 40 meters from the point of hit are counted and used in a formula to obtain a figure of effectiveness. This test is identical with the low panel test except that the bombs are actually dropped and fragment on impact rather than being set off statically. This brings in the effect of the forward motion of the bomb, angle from vertical at which impact occurs, and any delay in functioning, and thus gives a measure of the actual performance of the bomb.

Since the World War the development of fragmentation bombs has been undertaken in accordance with the recommendations of the bomb board. Small lots of several experimental types have been manufactured for test and the questions of proper type of metal, percentage of explosive content and total weight of bomb have been investigated. The latest experimental type, which has passed proving ground tests satisfactorily, is known as Bomb, Fragmentation, 30-lb. T 1. This type is now under manufacture for service test preparatory to standardization. The body is built up of rings cut from seamless steel tubing carried on an inner sleeve. The dimensions of the rings determine to an extent the number and size of fragments obtained.

The Common Defense

Maj. C. G. Mettler, Ord. Dept., U. S. A.*

IN discussing the broad subject of "The Common Defense," I expect to use all the platitudes, old sayings, historical recollections and trite expressions I can remember. I trust I may do this with personal safety.

An eminent author, Rupert Hughes, recently brought to the front page of our newspapers the atmosphere of the old Colonial days, when George Washington maneuvered around Boston with his army. Mr. Hughes has set many of us to thinking of the social practices of the days when the nation was born. I believe he did not intend, in any way, to belittle the character of General Washington, but to show that he was a man of his own day, who lived the life of his times and was a man among men. I merely mention this to get you back to the atmosphere of his day, in order that I may take time to orient you as to the national ideas which I desire to discuss.

In 1775, and even before that year, a few of our forefathers began to feel the call of nationalism and began to understand that a different organization was necessary to make them comfortable in New England than was required in England. They began to feel that it was possible to develop an organization in America which would better suit American conditons and would make all Americans happier. Surely they did not understand what this organization was. No one could foresee an independent nation, but all along the Atlantic Seaboard men were beginning to understand the meaning of this inward call—not all of them, I know, but a big minority. Disorder existing in the administraton of their affairs was repugnant to them, as it was also to many people in England. There were many promises of reform, but our forefathers had become confirmed pessimists like the lady who was mentioned by General Lord, director of the national budget, in one of his addresses. She was the arch-pessimist. She was married to an arch-optimist, who gloated over every adventure. One day, in Zion Canyon in Southern Utah, he began his rapturous admiration of the high, snow-covered peaks and crags extending up and up into the cold blue dome of the sky, and turning to her, with his voice full of enthusiasm, said, "My dear, aren't those mountains high?" She replied, "Only the tops of them are."

Order is the First Law of Nature

Well, this gives me the opportunity to use my first platitude: "Order is the first law of nature."

I like the sound of that one. It was questioned recently by a naturalist, who inquired, "Why then did nature make a million kinds of beetles when any sensible man knows that a dozen varieties are enough?" It is a hard law to understand, and I believe it is the last law learned by youth. Certainly it was in my youth, and has been my experience with many young men at West Point and in the military service.

Our ancestors attempted to apply that first law of nature to their own conditions, and in so doing, created the greatest possible disorder, the disorder of war. They must have had a great deal of confidence in the idea of eventually producing better order, for they kept up this war for eight years, living terrible lives, with hope many times almost gone, with their families suffering, with no supplies unless they hastened home between battles to plant and reap their crops. But, somehow, through all of this hardship, they kept the faith and kept their armies in the field, and by their perserverance, won a victory; a victory which is our great inheritance, a victory which is the original capital of every new born citizen of this country.

That was the first effort of the common defense. That was a part of the cost of building this nation. If we should attempt to evaluate our citizenship, we should set down in the figures the cost of those eight years of suffering, with our estimate of their value, based on the comfort of our homes and the orderliness of our lives.

Let us look at these forefathers at the end of this war, weary, and homesick, in a greater disorder than the one they were warring against and almost helpless as to the future. Everybody went home to think it over. There was food for much thought then. Security was forgotten. I believe the total strength of our Army the year after that war was some seventy privates of Artillery, stationed at West Point. The problem of constructing order out of chaos confronted the confederated states, the problem of how to live together in some sort of harmony when the different communities were separated by such great distances and such slow means of transportation and communication. The whole cry of the states was for order, the best order that could be obtained that was suitable to the conditions of America. A group of men was delegated to get together at Philadelphia and to begin the study of a suitable form of government to satisfy the American states.

Organization is the Beginning of Order

Here is my opportunity to use the next platitude: "Organization is the beginning of order."

I like that one, too. Perhaps it is overdone more than the other one, at least there are more organizations in existence today in every town in the United States than one is able to subscribe to with his whole pay check, and many of them are very desirable organizations to which to belong. I am going to mention a few of these later on.

The new problem of the thirteen states was organization. After a long debate, and after the most mature consideration of the multitude of problems which were encountered, and after the review of hundreds of schemes which were offered from all sources, the convention drew up a Constitution for the United States of America.

No human document ever received more earnest thought, more fervent prayer, more expenditure of mental inspiration than that precious scroll. That, too, is a part of our inheritance, part of the assets of American citizenship. It is a great part of the assets of humanity, because this scroll dedicated the American people to the service of humanity.

This document begins: "We, the people of the United

*Major Mettler is Assistant Military Attaché, American Embassy, London, England.

States, in order to form a more perfect Union, establish justice, insure domestic tranquility, promote the general welfare, provide for the common defense and secure the blessings of liberty to ourselves and posterity, do ordain and establish this Constitution for the United States of America." The document then proceeds to lay down the order in which things would be done, how much would be delegated to the general government and how much to the states, how much to the executive branch, how much to the legislative, and how much to the judiciary branches. To lay down a complete plan for a government which will stand the test which ours has stood for nearly one hundred and forty years, and to be still a wonderful example of stability and efficiency, is no idle task. I want to add to the praise already offered to these great founders my own small meed of appreciation.

The publication of this document was only the beginning of order in this country. It has taken many years to attain the order which now prevails, and we are now, in the eyes of many nations and of many students of government, young and disorderly.

May I now call your attention to the fact that our military plans have been a long time getting into order, that it required the world's greatest catastrophe to awaken us the necessity for such order; that in the midst of this disorder, and ever since that time, we have been striving to obtain an orderly system in our military affairs, and that, in spite of all our eoffrts, we have not yet reached a condition of order. I do not believe that the National Defense Act of 1916 and its amendment of 1920 are in themselves a satisfactory solution of our military problems. They do, in a way, correspond to the Articles of Confederation, under which we are working out a real constitution for our security problems. It takes a long while to make a plan for a little affair like your local clubs, and it will take a long while to make our country understand the need for the most efficiency in military development of national strength. Some day we are going to have a better plan, thanks to such organizations as the Army Ordnance Association, which is creating national thought of security.

Security is the Life of Organization

I think right now I may insert my third platitude: "Security is the life of organization." I am going to use all of these platitudes again, because I feel that they sound good and that you will not dispute them.

If we look at the great organizations of the world, which have prevailed a long time, we shall note in each a safeguard for its protection, and those which have had strongest protection have stood longest. Those, in which many organizations within the parent one took some part in the problem of security, have been able to go forward to their proper mission. I cite the examples of the Catholic Church, the Mohammedan Church and the Masonic Fraternity, alongside the examples of the Roman Empire, the Turkish Empire and the British Empire.

I have now reached the subject of my paper, "The Common Defense," provided for in the preamble to that most precious of human documents, the Constitution of the United States.

I take it that one of your principal interests is that somewhere down in your hearts there is a sense of looking after your inheritance to see that it is secure against intrusion and aggression, to guard it for the generations of your people not yet here, to learn how your representatives and agents are providing for its protection and to find out also whether any more effort is needed on your part to insure its absolute safety. It is my business to appraise you of these things as I see them and labor upon them for you and with you.

Let us look back again for a moment at the United States in the early days of its organization. I think, perhaps, no organization of the world started out as loosely as ours. There was jealousy in every direction. Men were doubtful at times whether the dissimilar states, with their many private and individual concerns, could so compromise their plans and their desires as to support the national government in its plans for the future. I am sure by the time the War of 1812 came along, the American Government had not found itself. It had not learned the necessity for security, and what security it had provided was without discipline. A small band of British soldiers, led by officers trained at Woolwich and Sandyhurst, wandered as they pleased over the land, brushed aside our untrained masses at Bladensburg and burned the capital at Washington. Our security organization was absurd. Our vacillating military plans were childish and foolish in the light of modern thought.

It required the preaching of the faith by many groups of men devoted to a great ideal to firmly establish the great organizations of the world. Our government is no exception in this respect. The formation of patriotic societies, such as the Society of the Cincinnati, the Sons and Daughters of the Revolution, the Colonial Dames, the Loyal Legion and many kindred groups stirred the people to understand the value of their victory and their liberties. They influenced the legislators and the executive government. They erected monuments to inspire the people. They set up a mental picture throughout the whole breadth of the country, which picture, after all, is America, is the United States. They built up traditions, established customs, made holidays and placed that spirit which is now our country in the subconscious minds of our own ancestors and ourselves.

Discipline is the First Law of Security

And here I come to my fourth platitude: "Discipline is the first law of security." I think, perhaps, I have gone all the way around a circle in these platitudes, for discipline, the first law of security requires order, the first law of nature. Perhaps, I have a higher sense of discipline than you have in mind. I mean more than order in my definition of discipline.

When cadets first come to West Point, they generally have a desire to obey, a desire to fit in to the general order of things and to do their best. Yet, during the first days, they are a ragged group, out of time, out of line and out of step. As they march along, you do not hear the steady thump, thump, thump of the marching feet of the old corps as it goes by to dinner or parade. But the older cadets take the new ones in hand and teach them their first lessons in the value of cadence, that same cadence—one, two, three, four; one hundred and twenty beats to the minute; two beats per second; left, right, left, right; hep, hep, hep. It is the secret of the marvelous drills and reviews at West Point. It is the secret of the greatest

application of power, applying all the power at one time at one place. It is the secret of winning battles, of moving armies, of striking the greatest blow at a given moment at a given place. It is the sense of harmony. It is why music is used to drill soldiers. By discipline, then, I mean the harmonious working together, in absolute unison, of all the elements of a command.

It was the lack of discipline that lost the Capital in the War of 1812, that nearly lost it after first Bull Run, that has cost this army thousands and thousands of lives in every war we have entered. It has been true through all history. You may read it in that interesting book of Spaulding and Nickerson, called "Warfare." It is something that will take a long time to learn.

Now, that I have my four platitudes established, I desire to go back and review them. The first one was "Order is the first law of nature." The antithesis of this may be said to be that war is the most disorderly thing in human society and perhaps the most unnatural thing in the world. Perhaps, there is no more inefficient thing in the world than an untrained army. This must be true, because if war comes upon a country, it is immediately thrown upon something with which it should not be familiar, if it be a peace-loving country. To take every citizen in any country and turn his thoughts from his peaceful pursuits to the pursuits of war, however strong may be his morale, nevertheless destroys his balance. He is anxious to help in every possible way, and in his anxiety, steps on everyone else's feet. I think, in the beginning of 1917, and even as late as the spring of 1918, the War Department at Washington was one of the most disorderly places in the world. Everyone was interfering with everybody else, and yet everyone had the intention of helping the Government in every possible way. Everyone felt that he was winning the war with his two hands and his loudest voice. It was a terrible task to bring order out of this chaos. I hardly know how it was done.

Our Government turned in every direction for help. The industrial executives rushed to Washington at a dollar a year in response to our signals of distress. We formed boards of every character to attempt a coordination of the power that came from every direction, but it could not be shaped in so short a period to operate in proper order. Even in the Ordnance Department, I can hardly understand how General Williams, with his smooth and even temper, was able to coordinate all the different elements of his department into the working machine that existed on November 11, 1918.

We have not forgotten our troubles of those days. In every possible way, we are now striving to establish an orderly system whereby this country may pass, without so much disorder, from the pursuits of peace to take up its arms and defend itself. We are not doing this for fear of any war that may come upon us soon. And as it took a hundred years to establish order in the national government for the pursuits of peace, we feel naturally that it is good to take a long time, even in these days of many thinkers, to establish order and organization for a far-off unknown war. We are seeking your help and your patriotic enthusiasm to establish order and to bring about a system which will operate with sympathy and efficiency, if such a thing as war should come to our nation again. As the Assistant Secretary of War, Col. Hanford MacNider has said, we have no threat in our voice or heart in preparing ourselves. Our preparation is a frank declaration that we mean to have peace, that we mean to insist upon less expense for armament, less suspicion and more openmindedness among neighbors, that we mean to help this world make itself a better place in which to live.

May I refer again to my second platitude, "Organization is the beginning of order."

Our Munitions Organization

I should like to go over for a moment the organization which General Williams has established in the Ordnance Department. In a way he is serving two masters, yet in the long run, he is serving only one. For certain part of his work, the Chief of Ordnance comes under the Chief of Staff, and for another part, he comes under the Assistant Secretary of War. These two officers are establishing a means of contact and a means of coordination which are bringing about a happy state of order. Under the Chief of Staff, General Williams has established a system of depots for the storage of munitions, has fitted his organization into the system of Corps Areas for the handling of the peace-time army, the Regulars, the National Guard and the Organized Reserves. He has established his part of the Reserve Officers' Training Corps in the colleges, in order that the older officers in the Reserve Corps may be replaced, when they have served their time and pass on. Heading up this work into his own office, through the Field Service and through his Personnel Section, he manages to disseminate, through this organization, a spirit of cooperation, but he desires, above all else, that this organization shall keep in mind its principal purpose, which is undoubtedly the inauguration and prosecution of war in the most efficient way. This is its great purpose, to which all others must be subordinated. Readiness to fit and work in his organization at the great moment when the bell rings is the beginning of order and strength. All other branches and services are organizing themselves in a similar manner with identical purposes.

The officers, which have been commissioned in the Field Service side of Ordnance work, must be prepared to take their places in the organization, not only partially prepared for their task, but in the proper spirit to carry on the work, without interference with their neighbors, prosecuting their own tasks efficiently and promptly within their circumscribed limits as defined in the basic organization. In order that this may be true, they must learn the limits of their work and the cadence in which it must be performed.

General Williams has organized, also, a Manufacturing Service in his office, and contacts from that division to the Office of the Assistant Secretary of War. He surveys, through this service, the whole field of munitions requirements and attempts to produce such designs as will properly compete with those of armies against which our nation might have to fight. Just as he reaches out, through the Corps Areas under his Field Service, to the military side and has his officers prepared for military duty, he reaches out, through the District organization under his Manufacturing Service, into industry and there attempts to prepare men for the proper coordination of their effort in producing the materials of war and its tools. In the District Offices, he is trying to establish an organization in

the midst of industry in which the order of things will fit the community in which his district is located, that people will be at the head of these districts who will understand the method of operation in the communities that the district serves. In other words, that a local government shall prevail under all those conditions which influence the actual effort of the community for the industrial work of war preparation.

With a few officers at Washington, he is attempting to hold this great organization together and to inject into it a spirit of preparation, that of preparing itself to move from one kind of work, that of peace time, to another, the work of war. The other special services are developing and strengthening a similar organization under the General Staff of the Army and under the office of the Assistant Secretary of War, and all of this work is a part of the great organization, planned for security.

I now come to the other platitude, "Security is the life of organization."

In a democratic government, such as ours, it is difficult to maintain a continuous effort in one direction on account of political changes and the condition of international economies. One Congress will appropriate a considerable amount of money for Ordnance work, and another Congress will cut off the money as soon as an organization is built up to match the former appropriations. At one time, funds are available for the training of the Organized Reserves and the National Guard, and at another time, funds are withdrawn. This is the business of government. It happens in all governments and must be expected and provided for. At times of small funds, contact with the small units of the great organization is broken. When contact is broken, you lose interest. You cannot help it, and neither can I, and we ask you for your help to maintain this organization intact in spite of political changes. It has very little means of maintaining itself in the widely expanded form in which it now exists. There must be thought from time to time of contracting. Certainly, there is such a thought in the minds of Congress. In the piping days of peace, the expense of national insurance bears heavily upon our pocket books.

In order to assist in holding this organization together, there have been formed many associations, known under various titles, such as the Reserve Officers' Association, the National Guard Association, and the organizations of the branches and special services.

The Place of the Army Ordnance Association

In support of the Ordnance Department, there has been formed the Army Ordnance Association, into which are gathered, in a more or less social way, all the men who are interested in the problem of providing the national armies with suitable tools. We have handed to that organization, in many ways, the problem of security, the questions of maintaining interest and of keeping you advised concerning the attempts which are being made to keep abreast of or ahead of the times in the design of tools and in the preparation for our final duty. I beseech your personal interest in this association and ask you to see that others, who might be interested in time of war in helping on the Ordnance side, are also interested and are given the opportunity to affiliate themselves with the association and help it carry this burden of security.

Every year, we try to save up enough work in the great proving ground at Aberdeen, to show the members of the Association, who are able to attend the annual meeting, the progress which has been made, not only in our Ordnance work, but in the work of other services with which the Ordnance Department must cooperate in the prosecution of its own work. We try, also, at that time to enlist some of the great national organizations, such as the A. S. M. E., the S. A. E., the aeronautical societies and others, to join with us in the annual meeting, to lend their sympathy and extend their interest toward the work we are trying to accomplish. Although the Army Ordnance Association is not a Government organization in a true sense of the word, it is in another sense the security organization for the great Ordnance combination which must work together to prevent war from coming to our shores. In a similar manner, your organizations of Reserve Officers and National Guard Officers are intrusted with the problems of protecting and building up the organization for the Common Defense.

Let me come again to my fourth platitude, "Discipline is the first law of security."

You who tried to make a place for yourselves in the great organization which was constructed for the World War, will understand how uncontrolled and undisciplined that organization was while it was being formed, and how before it learned cadence, it moved in one direction and another at the whim of any division whose chief attained ascendency over the others. Later, it learned to carry the procurement, the production, engineering and inspection in one direction, and they came into a more or less harmonious operation. It was difficult to do this, and under the character of organization we had established, it was sometimes impossible.

We believe a better organization has taken the place of that old one, an organization in which a group of men pursue one single object from the time of its original design until it is finally turned over for distribution to the Army. We believe that all men working on this particular item can get into step, can obtain a cadence of work, are able to operate in harmony and put maximum power into their effort. We believe this organization will be able to reduce and eventually eliminate many of the interferences we met with under the former system of operation. We in the Ordnance Department believe that, by separating the manufacturing work from the field service work, the officers in the Field Service will find the officers of the Manufacturing Division in direct unison with them and in a straight line from the factory to the depot, to the rail head, to the firing line, and that one group, specialized in its particular phase of work can, nevertheless, stay in step with another.

The last and greatest thing which we must learn to do is to exercise our organization, not in war but in simulation of the things which war may demand of us; the more we meet together the more simple becomes the problem of working together.

Our War Reserves

I have a fifth platitude, which I should like to use before I go on to some other part of my discussion, one that you have known from childhood.

"A bird in the hand is worth two in the bush."

And this brings up to my mind as an Ordnance Officer at once the question of the great war reserves. We had left after the World War an enormous quantity of ammunition and supplies stored away in our depots and arsenals, ready or partly ready for use in case of emergency. There is a feeling on the part of many people that these reserves are a useless expense. They cost us a great deal, even to maintain in their present condition, in depots and arsenals. And through unpreventable deterioration, they are slowly wasting away. Taxpayers like to dispense with the cost of maintenance and, if the reserves have any value at all, to sell them and have the money now instead of waiting until they gradually pass out of usefulness through obsolescence. We are anxious to hold these reserves, at least a sufficient amount of them, to organize our armies and supply them with some matériel in the early days of an emergency. We should like to keep them up to date by replacement and restoration of defective components. This is a valuable guarantee of peace, a serious consideration for anyone contemplating war against the United States. We do not want to waste our energies in caring for obsolete and useless inheritances, but we do want to use our best judgment in keeping such quantities and kinds of munitions as will be vitally necessary in the early days of a conflict.

You have, no doubt, seen and heard the great 16-inch gun batteries at the entrance to your harbors, and have appreciated that great power. I expect none of them to fire a single shot against an enemy's battleship. No battleship dare risk its existence under the trajectory of such a weapon. Nor would any nation risk its existence against the power of this nation backed up by substantial reserves of war material.

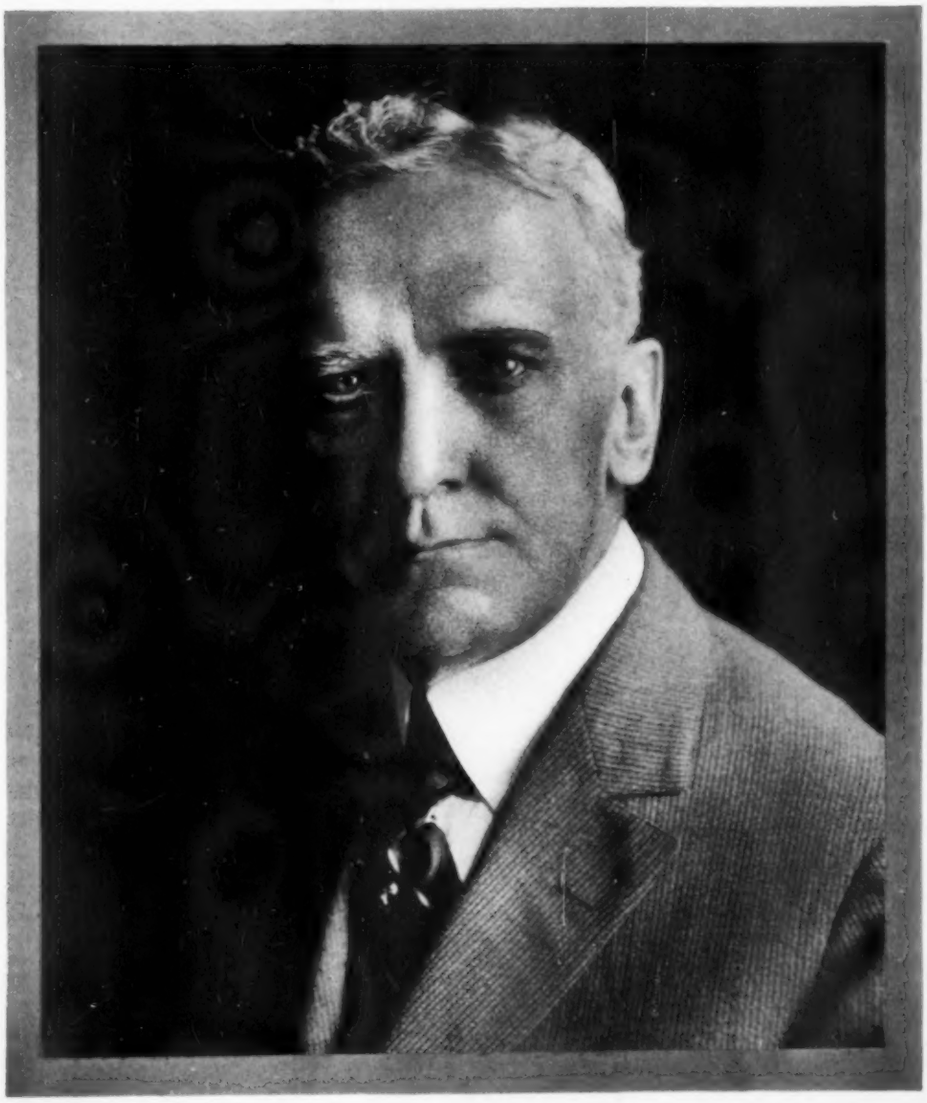
We have another potential reserve to which I would call your attention. We have six large manufacturing arsenals, at which we try to maintain a nucleus of men, ready to undertake the manufacture of munitions promptly at the outbreak of hostilities, men who are trained in this kind of work and who stand ready to teach the industrial people the most satisfactory means of accomplishing the final product desired. In the early days, the value of these arsenals will be a wonderful asset. Their output must not be sneered at because it will be of extreme value in the early days of emergency. I think we made a great mistake in the last war by our delays in using these arsenals.

Of course, with a large reserve, which we have on hand, it is impossible to obtain funds for additional manufacture of weapons except in the smallest quantity and the arsenals are not able to maintain themselves except at exorbitant costs for the manufacture of the small items for which they are given orders. I believe that these arsenals should be supplied with a certain amount of work in one form or another and the best thought of our whole organization ought to be given to maintaining them for their proper purposes during times of peace, and if possible, of making them of peace-time value. There exists here an opportunity to establish apprentice schools and manufacture for other branches of the Government. But even if such arrangements cannot be made, we should not lose sight of the immense value of our arsenals in maintaining at high standards the art of producing war munitions, taking this burden from our industries and placing it on the national government where it truly belongs. I firmly believe that our arsenals should be equipped to handle in a small way every phase of special munitions production and become the national centers from which industry may obtain full information whenever it becomes necessary.

We have another potential reserve in our engineering force which is interested in the design of war tools, not only in Washington, but distributed through the arsenals. This reserve is working toward the improvement of the tools of war with which our future armies must fight. Since the World War, we have been working on a program with a considerable amount of money developing new types. We have produced at considerable cost a great many new types. You, who are assigned to engineering work in the Ordnance Department, will do well to keep your minds upon the work of these divisions at the present time, and from time to time to see the results of the engineering work at the Aberdeen Proving Ground, especially at the annual meeting of the Army Ordnance Association. You should also be interested in seeing that this small group of engineers is kept in sufficient employment, that the engineering work of Ordnance is not forgotten in times of peace, that the knowledge of the design of the tools of war is kept as a potential safeguard.

The Rising Generation

There is another potential reserve to which I desire to call your attention, one that is now being threatened by an insidious propaganda, engineered by persons whose source of income is hardly understood. That reserve is the R. O. T. C. You have seen recently the action of some of our schools in New York City in allowing the students to vote on the question whether they would submit to compulsory military training; also, as to whether they would undertake any military training at all, and in many cases the students have voted by enoromus pluralities to eliminate all military things from their schools. This, I think, is not only due to the propaganda which is being carried on by various organizations in the country which are trying to reduce the potential power of the United States, but is being aided largely by the natural laziness of the youthful mind and body. As I said in the beginning of this lecture, the law of order is one of the last things learned by youth. There are brilliant exceptions to this fact, but from my own experience, I know that personal freedom in college is one thing a student attempts to obtain above everything else. Discipline is abhorrent to him. Anyone who shows him the way to get away from compulsory work of any kind is a friend. It is an easy thing to have a student vote against things which are good for the nation. He is, in a large measure, detached from his ideas of government while he is undertaking his studies in pure science and even from the very practical things by which he must earn his living. It is necessary for the older generation to show him, while he is in the formative stage, that the safety of his own future depends upon his preparing himself to defend his inheritance. It is necessary to point out to him the value of this nation, the value of the stock that he holds in this nation as one of its citizens, to make him understand that there is something more than his own little environment and his own little personal things which go to establish the standard of living which is maintained in this country. He is a potential reserve which cannot be overlooked. He is the leader of tomorrow.



GENERAL GUY EASTMAN TRIPP

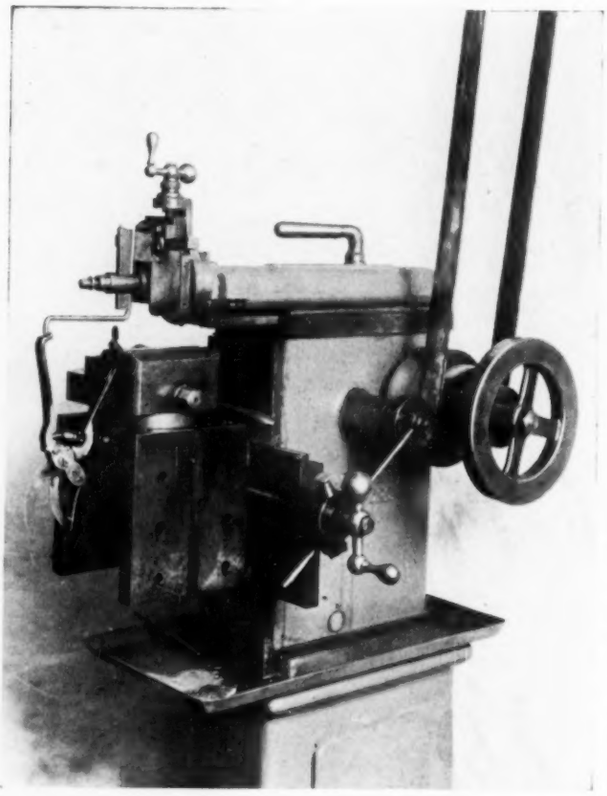
Died June 14, 1927

Vice-President, Army Ordnance Association
President, New York Post, Army Ordnance Association
Chairman, Westinghouse Electric and Manufacturing Company
Assistant Chief of Ordnance, U. S. A., during World War

Tool Testing as a Basis for Ordnance Purchasing

Maj. Carlos de Zafra, Ord. Res., U.S.A.*

DURING the past two years the writer, together with his colleagues in the Sage Research Laboratory at New York University, has had occasion to perform a large number of tests upon hand and machine tools of commercial manufacture. When this work was originally contemplated a source of specified tests was sought for use by way of criterion in conducting our own tests. As the Government, through its collective purchasing agencies, constituted the largest purchaser of tools and equipment, it was natural to expect to find tests prescribed in the various purchase specifications. In many cases this was so, while again it was not so for some of the most common tools. In such cases the judgment of the Government inspector or the actual service performance of the tool after purchase and issue, constituted the sole scientific (!) basis upon which many tools were and are purchased. Tools so purchased and tried out in service, which did not give a reasonable amount of satisfactory performance, would be black-listed, so to speak, and their manufacturers excluded from future contract awards. Many such specifications are in force. The purchase specifications of the Navy Department and of the Army Signal Corps, Quartermaster and Ordnance Department and others were carefully consulted and not infrequently the one was found to be a paraphrase of the other.



Pruning shears under test. The shears are opened and closed 10,000 times to ascertain the effect upon the spring.

In some cases, where tests were prescribed, it seemed difficult, if at all possible, to determine just what scientific principle underlay the test as prescribed. Still, in most cases where tests were prescribed, they served for as good a starting point as any in our investigations.

In short, the business of scientific tool testing was one of pioneering. Even tool manufacturers, as a whole, had no recognized or uniform method of testing similar products such that it would be possible to compare the product of one manufacturer with that of another through the media of test reports, for such reports, if they did exist, were not comparable. Therefore where any suggestions for a test existed—even the Bureau of Standards welcomed suggestions—they formed the basis of our initial test experiments and from them we developed gradually the scientific tests we are now employing for such staple tools as screwdrivers, claw hammers, pliers, lathes, etc., etc.

As our tests, under some classifications of tools, have now been sufficiently representative to warrant the conclusions so far deduced the writer strongly believes the lessons from such tests, as well as the tests themselves, to be of "proving ground" interest to members of the Army Ordnance Association, who have to do with drafting specifications and placing tentative contracts on the basis of actual tool performance.

The basic principles underlying our tests are covered in the following approach to each test:

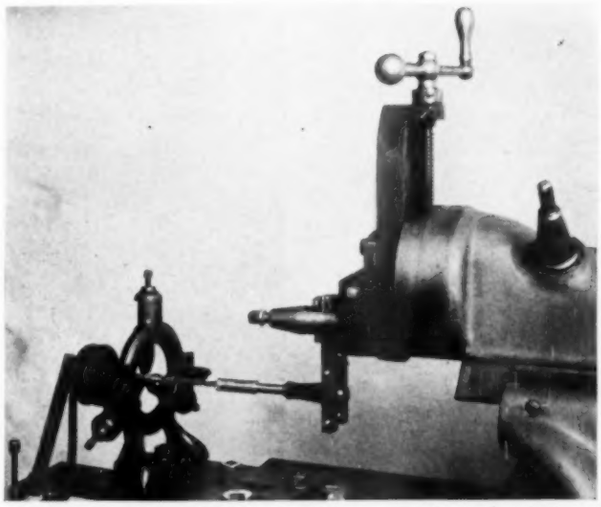
1. Is the tool of good design?
2. Is the tool of suitable materials?
3. Is the tool of acceptable workmanship?
4. Does the tool accomplish its intended work with due ease?
5. Does the tool suffer rupture or damage from normal use?
6. Is the tool sufficiently rugged to withstand reasonable abuse?
7. Are the manufacturer's claims within the reasonable scope of the tool's performance or are they exaggerated and superlative?
8. Is the tool worth the price charged?

From a long series of tests upon certain classifications of tools we are able to develop, within a relatively few hours of testing, all the stamina to resist service and abuse that would otherwise require many months of field service to determine. In other words, we can say definitely, as regards tools under such classification, that their suitability for the intended purpose can be deter-

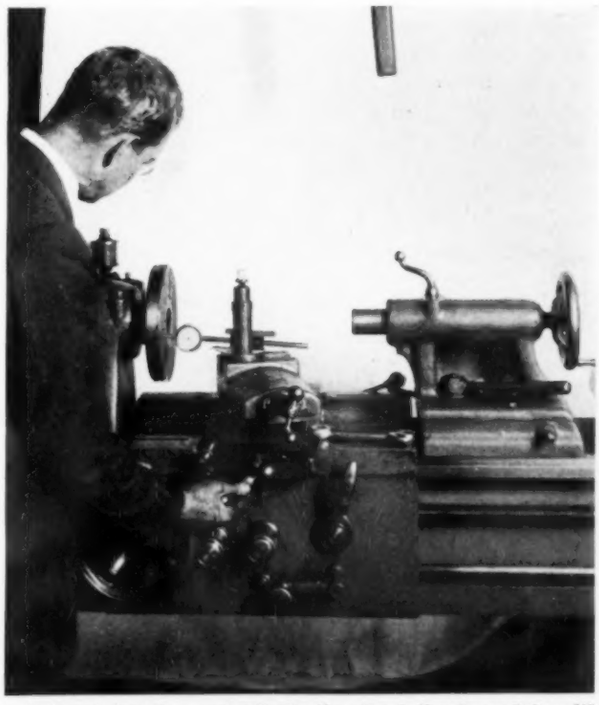
*Assist. Professor in Engineering, New York University. Chief, Testing Laboratory Section, N. Y. Ordnance District.

mined in advance of purchase and so emphatically determined as to convince even the manufacturer of a rejected tool that it will not suffice. This is possible because, by scientific means, the personal equation is eliminated and comparison of actual performance is possible along lines parallel and equitable to competitive tools.

To elucidate let us take up the screw driver tests. We found no scientifically prescribed tests available. We knew that ability to resist torsion was an essential attribute. Also that hardness at the blade end was essential. Also that by virtue of that necessary hardness the further element of brittleness was introduced. What was required, then, was a proper balance of all factors. Manufacturers could offer nothing more scientific than to insert the screw driver blade into the slotted end of a shaft onto which a lever arm was clamped, carrying a given weight for a given size tool. If turning the tool handle resulted in raising the lever arm and weights without loosening the handle or apparently twisting or breaking the blade the tool was passed. The War Department Specification No. 17-3 for Screw Drivers (Carpenter's, Electrician's, Machinist's) offered merely the following: "9. Tests. No special form or manner of tests is prescribed, beyond those implied by paragraphs 2 and 3" and such implications refer more particularly to items of inspection and broadly as to pattern and possible materials. We find (paragraph 2b) "in prescribing certain patterns of tools, or the materials from which they shall be made, it is the intent of the specification to indicate preference for such as is considered best suited to the purpose." The Navy Department Specifications —41S9a — furnish more data as they include, for each size listed, a torsion stress test in inch-pounds, to be withstood. Also a more complete table of dimensions and tolerances for each size listed is given. Even though the tool may withstand such tests as above suggested they do not suffice to indicate if the tool was on the verge of failure or how much greater load it could withstand. Such tests are unscientific —mere guess work—serving only to establish a minimum grade to pass as it were. In our tests, to establish "maximum averages" which should be attained we test to destruction and thereby often develop interesting data to the benefit of the manufacturer. For months prior to our series of screw driver tests, made on the products of one manufacturer in particular, the sales representative of a certain steel mill had unsuccessfully been trying to book an an order from this manufacturer. The manufacturer felt the higher cost of the new steel to be unwarranted in his product, notwithstanding some of his competitors were using it in their products. Scientific tests showed him, however, that every one of his screw drivers broke because of brittleness—not because of abuse—and the character of the break substantiated the fact that the material used could not, when properly tempered, stand up to the load it should carry for its size. The product was well made, of good material, but not of the material best suited for the intended purpose. The tool was a universally good seller, workmanship and finish excellent. But—and here is where our particular interest comes in—such screw drivers would not be suitable for gun kits or the equipment of maintenance units because they would break when subjected to the severe service stresses — stresses they would infrequently meet in the usual household and even garage service. I might add that the steel salesman has since booked his order.



Testing spiral ratchet screw driver. Having micrometered all parts in advance of test, they are carefully measured again after a run of at least 10,000 strokes against a brake resistance equal to that previously determined by driving No. 12 screws into yellow pine.



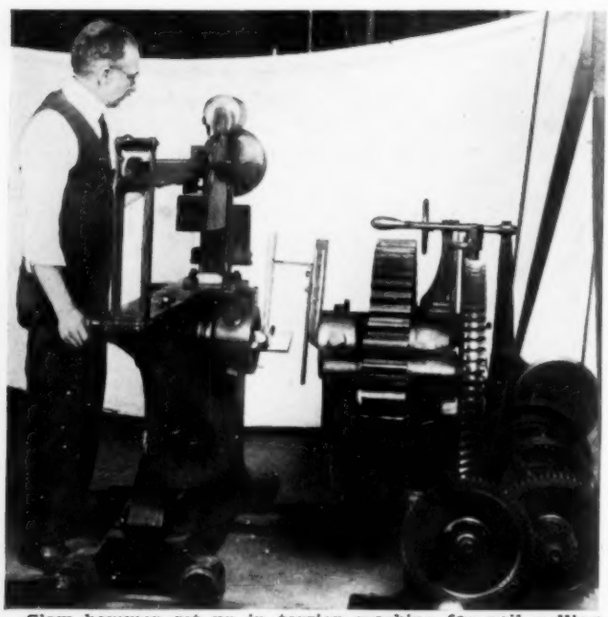
Determining the perpendicularity of a lathe face plate with respect to the bed and compound rest.

In the set up of a ratchet screw driver undergoing the torsion test weights are added to the lever arm which denotes on a scale the arc or angle of deflection. The blade is in a fixed slot while the handle is free to turn. As soon as failure is about to occur the pointer on the scale, instead of coming to an abrupt stop upon the application of additional weight, continues gradually to descend. By reversing the

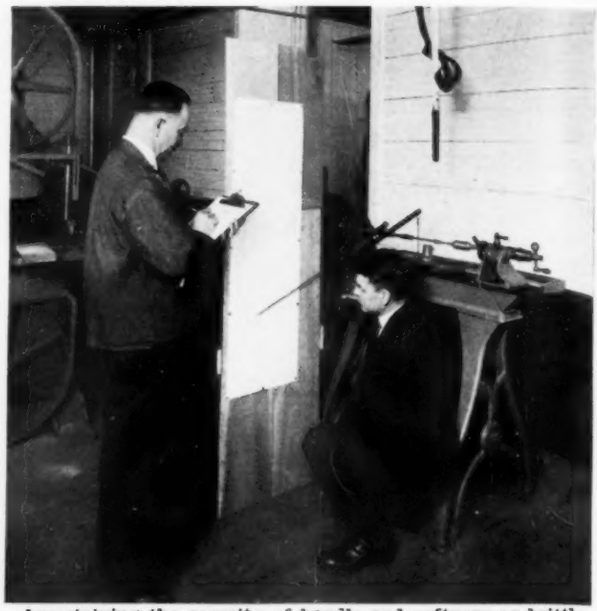
test of the manufacturer from lifting a given fixed weight to holding suspended a gradually increasing weight, we can detect the angle of deflection at which failure began to manifest itself as well as the final angle of torsion at the instant of breaking. From a series of such tests a curve is plotted showing the angle of deflection and the inch-pounds leverage for each weight applied and the final limit of strength. The average of these curves, for any given size tool, shows at a glance what any untried screw driver in the same class *should* accomplish, so that, if it equals that performance on test, it is acceptable and need not be tested to destruction unless desired or approach to the yielding point becomes apparent.

Ratchet and spiral screw drivers and similar tools, in addition, are dis-assembled and their moving elements listed and carefully micrometered and then re-assembled. They are then placed in a specially constructed testing device which provides for a uniform resistance equivalent to that offered in driving a screw into hard wood. After ten thousand strokes have been made the tool is removed, dis-assembled and the elements again micrometered. A good tool will show no appreciable wear whereas a cheap tool, or one made of inferior materials, will readily show wear through comparing the micrometer readings taken before and after the test. In the case of a drill brace, sixty-five thousand revolutions will constitute the basis of comparison.

Interesting tests have been conducted on various claw hammers to determine their relative merits. For comparative purposes tools of the same size and weight are selected, or at least, those which are offered as suitable for the same range of service. As regards claw hammers, they too are subject to manufacturer's claims for perfection, so that the average mechanic can tell only after some little use, just what the advertised advantages



Claw hammer set up in torsion machine for nail pulling and handle tests. Claws are supposed to grip the shank of a 20-penny nail which has been inserted and doubled up and over a steel plate and pull it through without damage to hammer or handle. For the handle test the claws grip a bolt and the handle is pulled back to destruction. Two thousand inch-pounds are acceptable although 4,050 inch-pounds have been recorded.



Ascertaining the security of handle and softness or brittleness of tip of screwdriver. Weights are added gradually and the degree of distortion noted. Cumulative data curves are plotted to determine standards to be met by acceptable tools.

may or may not amount to. Some manufacturers claim an advantage because of their particular method of wedging in the handle, others because their method of assembly relieves the hand from the fatigue of shock, etc. It is interesting to note here that in the case of one nationally advertised product the very detail featured proved on tests to be undesirable. In the case of another, not so widely advertised, but introducing a particular shock absorbing feature, this feature not only did not accomplish the claimed result but actually accentuated the undesired reactions. It is interesting to note further that four mechanics were each blindfolded and handed three hammers of different manufacture and features, for the purpose of hammering on an anvil, as long as necessary, to select that hammer from among them which gave the least reaction or shock. After carefully hammering and re-hammering until each felt there was no question in his mind as to which was the most desirable tool, they were then advised as to which tool it was—that is to say—they did not know at any time during the test which hammer they were using. They did not "feel" the hammer other than to hold it at the grip. Curiously enough all the special-feature hammers were rejected and all chose the same hammer devoid of such features. Again, curiously enough, hammers of this manufacture stood out in bold relief in the results of all of the other physical tests conducted in the laboratory. Among these tests is one on the gripping power of the claws, the strength of handle, the degree of security with which the handle is wedged in, hardness of metal and proper heat treatment, etc. Laboratory tests prove conclusively in a few hours what possibly as many months in field service would require to develop. And, as a consequence, for the purpose of ordnance issues, it is readily possible to determine which tools should not be considered and the order in which preference should be given to those passing such tests.

I might go on and cover a number of standard tools

only to parallel the above. But let me introduce now another phase of service. Combination tools, that is, those tools performing the functions of two or more separate tools, are sometimes most desirable in that they reduce the number of parts and weights to be carried. However, when a new combination tool is offered, it too should be subjected to the most complete tests to avoid its issue to troops if it is not equal at least to the separate tools it displaces. Recently a Western manufacturer sent us a double purpose tool for test which the average man would be tempted to buy on those features alone which we regard as purely "selling points," consisting of features which command a logically favorable response in the mind of the prospective purchaser, yet which, in practice, have no real merit but possibly actual demerit. The shock-absorbing hammer was an illustration. We had also a combination pliers and adjustable open-end wrench. Not only was it promptly condemned because its design was such that we could readily forsee possible painful injury to the fingers should the tool slip while force was being applied, but the physical tests carried on irrespective of the design, proved the device to be made of materials absolutely incapable of withstanding the average stresses reasonably to be expected in normal service. On the other hand, if properly redesigned and made of properly selected materials, the desired two-fold purpose of the tool could be accomplished readily. The manufacturer protested (as sometimes they do) the rejection and, on request, furnished two additional specimens for further tests. The findings of the first tests were more than substantiated in the second and third series. On the other hand, we have successfully tested tools for similar service, most excellent in design and of ample strength for rough usage.

Machine tools, likewise, are subject to tests for accuracy of work performable, quality of materials in their construction, design features, etc. A saw filing machine which its manufacturer claimed would do the work quicker and better than hand filing, was found to be ruinous to the saws. The manufacturer later admitted his machine had been sent out untested owing to the fact that demand was greater than his plant could supply. That was evidence of the desirability of a tool for such purpose. He sent certain improved replacement parts with which we made further tests but with the same conclusions. We tried the device on various types of saws and found that hand filing was quicker and safer for the saws. Pliers of various types and sizes, have formed an interesting series of tests, resulting in a wide variance in data secured. However, the tests now have been sufficient in number for various types and sizes to make possible the establishment of specific minimum limits as to weight, cutting capacity, resistance to handle compression, clearances and hardness, etc., falling below which a tool merits rejection.

During the past two years we have tested over seventy classifications of tools submitted by 45 manufacturers and 41 classes of radio materials and parts submitted by 176 manufacturers.

In concluding it may be said that the relative merits of power and hand tools can be fairly and definitely established in the laboratory by a laboratory staff composed of a personnel trained not only in laboratory technique but who have also served their apprenticeships in the shops, working for years under industrial conditions and who, by virtue of such trade training, instinctively know what to look for in tools other than mere physical qualities.

For ordnance purposes the test data obtained and to be obtained, will provide for the statement of basic limitations in specifications, more scientifically determined than heretofore and more fair to the manufacturer and his product.

Discussion

Maj. J. B. Rose, Ord. Dept., U. S. A.
TECHNICAL STAFF, OFFICE OF THE CHIEF OF ORDNANCE

THIS paper is very timely and interesting in view of the present efforts of the War Department to improve and complete its specifications, and also in view of the attention which methods of procurement are being given at this time.

The practice of establishing satisfactory qualities of various tools by actual test should be of great advantage to the purchasing agent. It is interesting to note, however, that the government stands in a rather peculiar position with regard to purchases made by it. It is mandatory that supplies shall be purchased from the lowest bidder. It follows that there must be an equality of bidding and therefore the specifications must be very explicit and complete as to characteristics and quality of the article desired. This paper very properly points out the fact that at least some government specifications are not so drawn.

Federal and Departmental specifications are for the most part so drawn that they will insure delivery of supplies which are satisfactory for the purpose intended, but in general these specifications do not demand the highest grade of an article, but specify a grade which should ordinarily be serviceable and satisfactory. This practice, therefore, prevents recognition of articles of superior quality as those who may bid on such quality must compete with those who bid on a quality which merely comes within the specifications.

The above consideration does not detract from the advantage of knowing the relative merit of various tools or similar articles, and the establishment of some means of properly determining relative merit is a matter of considerable importance as such tests then properly become a part of the specification under which purchase is made.

This is all the more necessary in that it is the policy of at least the War Department to avoid the use of trade names, and if quality cannot be established by the use of a trade name, and the reputation of the manufacturer, it is necessary to establish this quality by specific tests of quality and performance. The suggestion which the writer makes regarding tests is, therefore, entirely within the present policy governing preparation of specifications.

It is a most difficult matter to specify a means of inspection or test that determines relative merit among various tools of the same character, and it is for this reason probably that so many specifications are imperfect in this respect as the writer has noted.

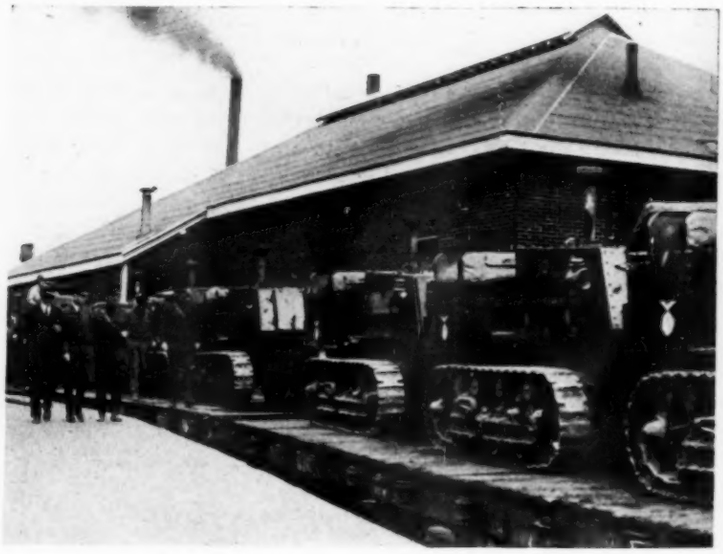
Ordnance in the Orient

Chinese Factions Proficient with Small Arms

A company of Chinese soldiers, armed with modern small arms, being trained in the use of the automatic pistol. Part of the target practice training includes the speedy reloading of the gun after firing.

American Ordnance Goes to China

A long line of tractors at the Marine Base, Quantico, Va., loaded aboard cars on their way to China. This equipment was sent by rail to the West Coast where it sailed for duty with the U. S. Marines in the trouble zone at Shanghai.



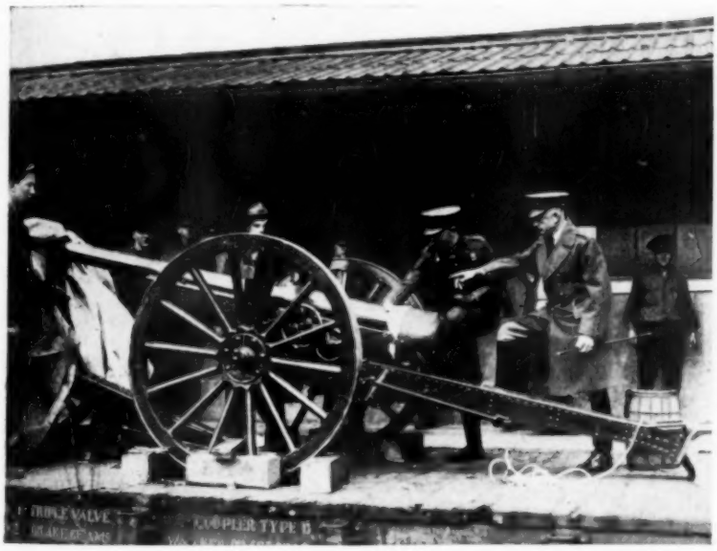
Dentists Must Be in Demand

These troops of Marshal Sun Chang Fang at Shanghai are not partaking of the daily ration—they are merely loosening with their teeth the caps of 3-inch shell preparatory to firing against the Cantonese troops.

China Arms with Modern Weapons

Equipment of the Chinese Infantry

Foot soldiers of the army of Sun Chang Fang, rifles ready, theoretically have their backs to the wall in their effort to stave off the advance of the Cantonese troops.



American Field Guns China Bound

Marine Officers at Quantico, Va., make final inspection of weapons to accompany U. S. Marines to duty in China. This and other necessary equipment was shipped to the Orient via San Diego, Calif.

Chinese Bombers Active

Two members of the Aukuochun (Anti-red) Air Force about to start on flight carrying bombs destined for the strongholds of the Northern Army in China.

Explosives—Past and Present

Cadet Edward W. Chamberlain, U. S. M. A., '27

IN the year 718 A. D. the city of Alexandria saw the return of the mighty battle fleet which had set out two years before with Mohammed's battle flags flying from its mast heads. Of the eighteen hundred galleys that had sailed out of the harbor to level the walls of Constantinople, the Imperial City, five broken ships crept back and their crews told fearsome tales of the horror that had fallen upon them. They had sailed confidently into the Bosporus and the Greeks had come to meet them. They were about to engage when suddenly walls of flame shot from the Christian galleys and all the thunder and lightnings of heaven had fallen upon the unprotected heads of the Chosen. The Arab galleys had burnt to the water's edge; their crews, mad with fear, had leaped into the water and had been drowned or speared by the waiting Greeks; the fair city had not even been approached. Such was the tale that was whispered about the public houses of Alexandria and even hinted about by the leaders of the party then out of favor with the government. We are little interested with Moslem polities of that period but the account of the destruction of the grand fleet is worthy of notice because it is the first mention of anything approaching the use of explosives in warfare. It marks the beginning of the end of club and spear as weapons of war and foreshadows the birth of the rifle and the cannon.

The author of this paper, Cadet Edward W. Chamberlain, a member of the First Class, United States Military Academy, was awarded a prize of $50.00 offered by the Army Ordnance Association to the member of the First Class at West Point who submitted the best essay on an Ordnance topic or a related subject.

The flame that so terrified the worthy followers of the Prophet was what has been called "sea fire" or "Greek fire." Strictly speaking this mixture of sulphur, pitch, naphtha and possibly resins was not an explosive. It was rather a highly inflammable mass that stuck to whatever it touched and burned with an intense heat, a good deal of noise and more smoke and flame. Although accurate information is not to be had it is probable that it was projected from a flame thrower, similar in principle to projectors used for that purpose on the Western front during the last war, and that it was ignited as it left the nozzle. A modification of this sea fire had been used against the invading Turks some fifty years before in a previous attempt to capture Constantinople. In this instance the Greeks had poured the flaming liquid upon the heads of the besiegers who were trying to breach the wall and no attempt to project it had been made. However the fiery stuff had proved quite as formidable a weapon of defense as it did half a century later and became an established part of the defensive system of the Greek army.

Progress in the line of explosives was slow however and it is not until about the year 1250 A. D. that we find the Moslems (who apparently had profited by their sad experiences in the East) using a mixture called "Flying fire" in their conquest of Spain. The appearance of this mixture is important because it is the first to contain saltpeter or potassium nitrate and can be rated as the first real explosive. The Chinese had made discoveries along this same line and there is reason to believe that they knew of the properties of gunpowder even before its appearance in the West. Records of unknown authenticity state that the Mongols used a substance containing saltpeter for the purpose of blowing down the walls of Persian cities as early as the tenth century; but 1200 A. D. is the year commonly accepted as that in which gunpowder, as we know it, made its appearance. It was fully fifty years after this that it was found that in addition to being employed as an explosive to blow things to pieces the black powder might also be used as a propellant. This was a revolutionary step and from here on progress was increasingly rapid.

First Efforts at Uniformity of Powder

In military writings of the fourteenth century we find this formula for the manufacture of gunpowder to be used as either a propellant or a disruptive: "4 pounds of saltpeter, 1 pound of sulphur, 1 ounce of sal practica, 1 ounce sal ammoniac and one-twelfth part camphor." Every powder maker had his own idea of the proportion of the ingredients and the way in which they should be treated to produce the finished product. In this way powder of every imaginable quality and grade was produced. It is not hard to picture the result as far as military use was concerned. The projectors, for they had not yet attained the dignity of the title, guns, were at best woefully inefficient and inaccurate; their shortcomings combined with the nonuniform powder made the possibility of hitting anything practically zero. It was to remedy this that we have the formula given above. The different powder makers were required to make their products conform to these specifications and the result was quite a good explosive for that day. It might be well to add that the camphor in this case was added because it gave a greater strength to the powder, not as the makers believed through some inherent quality of its own which it imparted to the mixture, but because it bound the mixture together and permitted greater speed of combustion and consequently greater pressure in the tube.

The first powder was known as "Serpentine" and was the fine mixture of the three ingredients as they stood

after pulverizing and mixing. This product was hard to handle; it deteriorated rapidly and required immense care in loading to prevent either a burst in the bore or such small pressure that it was ineffective. About the middle of the fifteenth century molded and cemented powders began to replace the powder variety. In records under the date of 1425 we find mention of "corned" powders or powder made by mixing serpentine with water or a camphor solution, allowing the paste to dry and harden and then breaking in into lumps of a suitable size. These powders were much more powerful than the fine had been and at first considerable difficulty was had in preventing them from breaking the gun in which they were used. In 1525 a method of sorting these grains by passing them through sieves of varying sizes worked still further towards uniformity in black powder; in 1784 the idea of pressing the cakes under the action of a hand press was conceived and found to secure excellent results. The pressing increased the density and made the burning of the cake more regular. A few years later a screw press replaced the hand press and was in turn replaced by the hydraulic press. After pressing the grains were broken by wooden mallets weilded by handpower and then were tumbled about in wooden cylinders, not unlike barrels, to give a polish to the grains. Thus developed the method of present manufacture which, up until the introduction of smokeless powder, produced the medium for both propelling charges from a gun and furnishing the disrupting forces of those charges. Smokeless powder has almost entirely replaced blackpowder as a propellant now and more powerful compounds are rapidly forging ahead of it in the realm of disruptives but black powder is the oldest of them all and to it we owe much of our present state of civilization.

Era of Experimentation

Between 1850 and 1870 many men in this country and also in European countries were experimenting in an effort to produce a gun that would fire satisfactorily when rifled. The main difficulty was to find a powder that would not break the gun when it encountered the resistance of the projectile due to rifling. All guns of any size previous to this time had been smooth bores and the projectile they fired was of such a size that there was plenty of clearance between it and the bore of the piece. Excessive pressure was thus taken care of by the escape of powder gas around the sides of the shell. With the obturation afforded by the tight fit of the rifled gun and its shell such an escape was impossible and as a result many guns ruptured. After much research it was found however that if the burning of the powder charge could be sufficiently retarded and the pressure built up gradually this difficulty would be removed so it was toward this end that experts bent their energy. Some progress was made along the line of black powder manufacture by partially burning the charcoal instead of burning it completely. This produced what was called "cocoa" powder, brown in color, slow burning and quite uniform. It was about this time however that smokeless powder was to make its appearance and with its coming all attempts to improve black powder for use as a propellant ceased.

In 1845 Schoenbein found that by treating ordinary cotton with a solution of nitric and sulphuric acid a compound could be obtained which kept its original physical characteristics, that is remained cotton in its external appearance, but had acquired a high degree of inflammability which gave it promise as an explosive. The discovery immediately stimulated further research and several plants were established in England and France for further investigation of the phenomena. Unfortunately most of these first plants were destroyed by premature explosions of the substance under investigation and for a time it appeared that the idea would be discarded. Von Lenk in Austria was the only one of the many who continued his work in the face of such discouragement. He believed that the failure of his associates had been due to the fact that the cotton was not sufficiently purified after nitration and as will be shown later, his assumption was correct. Von Lenk tried out a very lengthy plan of washing which required much boiling of the product in various alkalis and further soaking in running water but his results were not satisfactory. Other magazine explosions in Austria, caused by the unstableness of the cotton, forced him to abandon his plan. Up until this time the cotton had been treated in long strands just as it came from the gin and it was due largely to the wispy character of the cellulose that the purifying process could not be complete and the resulting compound was unstable.

In 1864 Abel, an English chemist, interested by Von Lenk's failure, began a series of experiments for the purifying of the fiber and met with astonishing success. Abel tried the expedient of pulping the nitrated cotton, that is cutting the fibers into short lengths, and by this means found that they could be washed to the desired state. As in the case of many inventions, this process was discovered by accident. Abel first tried pulping in order to compress the cotton more thoroughly and so obtain a more uniform burning. The pulping failed to accomplish this but in his experiments he found that by so doing he could purify the product to such a degree that compression would be unnecessary. The evolution of smokeless powder made long strides forward from this point and in the period from the close of the American Civil War to 1890 a great number of powders and propellants of varying degrees of usefulness made their appearance. In 1885 Vielle, a Frenchman, perfected a process of colloiding the nitrated cotton; he dissolved it in ether and formed a colloid or jelly. In 1886 he produced a perfectly colloided powder, made from the nitrated cellulose and moulded into grains of a uniform size. Three years later Nobel invented an explosive which he called "ballistite" and which was more powerful than anything that had been known up to this time. His patent was a nitrated glycerine and was in flake form. Close on the heels of this came the invention of "cordite" in England and in 1890 a Russian scientist varied Vielle's process slightly and produced a highly satisfactory smokeless powder which he called "pyro."

In the United States experimental work was also being carried on with varying degrees of success. In 1909 however both the Army and Navy turned for their supply of explosives to the Du Pont Company and for the first time the two services had a common standard for their needs. Up until this time the Army had used a double

base powder almost exclusively while the Navy had always used the single base powder which was almost identical with the Russian "pyro." Neither service depended entirely upon private concerns and in 1900 the Navy established a large plant at Indianhead, Maryland, and began to manufacture smokeless powder on an increasingly large scale. The Army built a plant at Picatinny, New Jersey, some seven years later for the same purpose. These plants, while not large enough to furnish the entire amount of explosive necessary for military purposes, still maintain the supply at such a level that it is easily completed by private concerns in time of peace. In case of an emergency it would be possible to expand the plants, both government and privately owned, so that the supply of explosives would be adequate to meet the increased demand.

A discussion of explosives and more especially one of propellants brings in the question of the means by which these propellants are handled from the time that they leave the arsenal to the time that they are inserted in the gun for firing. By that I do not mean the manner in which they are transported or stored but rather the containers in which they are carried and the method by which they are introduced into the gun.

Our first powder was serpentine and we found that that was a finely granulated powder, so fine in fact that it was almost like dust. In this form it was extremely difficult to handle, hard to carry about and almost impossible to load. Cannon and mortars were loaded by means of a small scoop or shovel and the powder was ladled into the breach much the same as sand is shoveled into a pail. It was small wonder that poor results were obtained under such conditions; indeed it is a wonder that any results were obtained at all. With small arms the process was even more complicated. The powder had to be coaxed into the narrow bore a little at a time and if the bore happened to be rifled the difficulty was doubled. Because of the time required to load Napoleon withdrew the rifle as a weapon of his armies and replaced it by the smooth bore. With the advent of corned or grained powder loading became easier. The polish of graphite on the grains rendered the powder less susceptible to dampness and consequently it could be carried in much less bulky containers and it retained its power much longer. It was easier to load and it did not settle so tightly in the breech, hence it was more powerful and less was required. It was more uniform and better results could be expected and were obtained, not only in effectiveness but in accuracy as well. General Rodman invented the perforated grain and soon after this the idea was conceived of having a fixed cartridge, that is a charge, predetermined and put up in a container of some sort so that the charge would be the same always and would be more convenient for the user. For small arms paper containers found favor and the close of the Civil War found both the North and the South using a paper cartridge which was torn by the teeth before it was inserted in the rifle and then was fired by means of a percussion cap. In cannon, cloth bags were used with varying degrees of success depending largely on the kind of the cloth and the size of the cartridge. Silk was found to be the most satisfactory and for a number of years has been used by both the Services in this country. The silk used is a coarsely woven cloth resembling burlap and is especially valuable in that the fiber does not smolder. The charges are put up in packages of a certain size which are not too large for one man to handle and a certain specified number of these packages make up the total propelling charge. In certain of our matériel, more especially in coast defense mortars and in howitzers, the charge is varied according to the desired range and a package is added or taken away as desired.

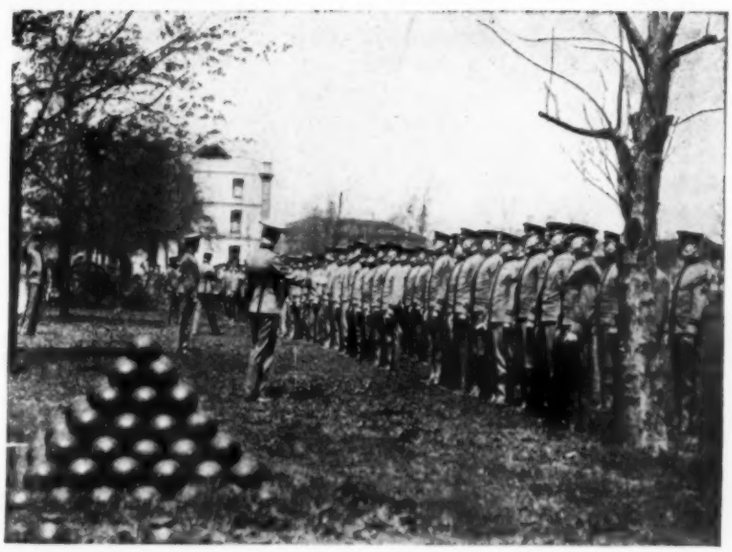
From paper cartridges for small arms developed the brass cartridge with the projectile, the bullet, also fixed so that the entire unit, primer, propellant, container and projectile are contained in a single small compact package which is easy to load, easy to handle and not easily damaged. Every one is so familiar with rifle ammunition that a description of it would be superfluous. Guns up to and including the three inch in our service have fixed ammunition. Larger than that the projectile forms one element, the primer a second and the propellant a third. In matériel of other countries, notably Germany, this list must also include a short cartridge case which itself contains the primer and which serves as an obturating device to prevent the escape of powder gases to the rear. The need for such a device is occasioned by the type of breech block used. The Germans use a sliding block in which an obturator cannot be incorporated and the case, though unwieldy, hard to handle and harder to transport, becomes a necessity. In American matériel obturation is taken care of by devices in the breech block itself.

Such, briefly is the history of the development of explosives from the crude rockets and fire bombs of the Moors, through the inefficient and cumbersome black powder or serpentine, which hurled small stones a distance of a few hundred yards to hit a target—sometimes—to our present day smokeless powders, which throw a twenty-four hundred pound projectile some thirty miles with an accuracy that is uncanny. The story of powder is one of interest and fascination.

Ordnance News in Pictures

West Point Cadets at Aberdeen Proving Ground

The members of the 1st Class, U. S. Military Academy, made their annual visit to the Aberdeen Proving Ground April 28, 1927. The future generals are shown here inspecting some of the tanks and self-propelled guns at the Proving Ground.



U. S. M. A. Cadets Visit Frankford Arsenal

Enroute to the Aberdeen Proving Ground members of the 1st Class of West Point Cadets visited the Frankford Arsenal, Philadelphia, Pa. The students were shown through the various manufacturing and development divisions of the huge ordnance establishment on the Delaware.

Ordnance Curios of G. B. Jarrett, Haddonfield, N. J.

The collection of armament and weapons of Lieutenant Jarrett, Ord. Res., a member of the Army Ordnance Association, is regarded one of the most interesting in this country. It includes 75 types of bayonets, 35 rifles, 18 pistols, 14 machine guns and 18 gas masks.

Editorial

General Tripp

TO announce the death of Gen. Guy Eastman Tripp, a Vice-President of the Army Ordnance Association, is to record the passing of a civilian leader of rare attainments. General Tripp died in New York City, June 14, 1927.

Born in Wells, Maine, April 22, 1865, he obtained his early education at the South Berwick (Me.) Academy. At 18 he was a clerk with the Eastern Railway Company at Salem, Mass.; at 23 chief clerk of its maintenance of way department, and at 25 storekeeper for the Thompson-Houston Electric Company. Later he was a traveling auditor for the same organization. In 1897 he became associated with Stone and Webster engaged in the construction and operation of public utilities. He rose to the Vice-Presidency of the Stone and Webster Management Association and the Stone and Webster Engineering Corporation. In 1910 he served as chairman of the Joint Committee on Reorganization of the Metropolitan Street Railway Company of New York City. His work in this capacity proved his executive genius and lead to his selection in January, 1912, as chairman of the Board of Directors of the Westinghouse Electric and Manufacturing Company, which office he held continuously until his death —except for the period of his service with the Ordnance Department, U. S. Army, during the World War.

On January 16, 1918, he was commissioned Colonel in the Ordnance Department, and in recognition of his excellent work as Chief of the Production Division, Office of the Chief of Ordnance, he was appointed Brigadier General, August 23, 1918, and assigned to duty as Special Assistant to the Chief of Ordnance in charge of Ordnance Districts. The establishment of Ordnance Districts for the production of munitions with a view to decentralization of authority relating to matters of administration, production, inspection and shipment of munitions was one of his outstanding contributions to the success of the Department in meeting its huge war-time responsibility. For his eminent service to the nation during the War General Tripp was awarded the Distinguished Service Medal. He returned to civil life shortly after the Armistice.

Recognizing the importance of munitions preparedness in our national defense, General Tripp continued his active interest in these matters after the War. In 1919 he served as a member of the Founders Committee of the Army Ordnance Association, and upon organization became one of its directors. He served the Association in this capacity until 1926 when he was unanimously elected a vice-president. In 1921 he assisted in the organization of the New York Post, the first local post of the Association, and served as its president from its establishment until his death. He was also a member of the Advisory Board of the New York Ordnance District.

Always active in promoting ordnance preparedness, his last undertaking in this field occurred when, as chairman of the Committee on Industrial Preparedness of the National Association of Manufacturers, the "Tripp Board" urged congressional legislation to provide educational orders for non-commercial classes of munitions.

In recent years General Tripp was particularly concerned with the future of electrical development in the United States. He had spoken and written much on the subject, presenting a fascinating picture of the United States of the future in a detailed plan for the electrification of the entire country under one great system for all transportation, factories, farms and homes. His plan has been called the greatest electrical project ever definitely proposed. In the March-April, 1926, issue of this journal he discussed "Super-Power From a Military Standpoint," pointing out the immense value of electric power development to adequate national defense.

In his untimely death the Army Ordnance Association mourns the passing of a sincere friend and counselor, an active officer and member, a standard bearer in the cause of national defense whose devotion and fidelity to the things he held dear are an inspiration.

Lindbergh Points a Moral

THE epoch-making trans-Atlantic flight of Col. Charles Lindbergh, A. C. Res., U. S. A., probably has occasioned more interest in a shorter period of time than the accomplishment of any individual of our day or perhaps of any other day. His courage, ability, and personality, in one fell swoop, have placed him high in the estimation of all who admire these attainments. He deserves all the honors that have been lavishly heaped upon him at home and abroad. Aside from the fact that this "ambassador without portfolio" learned to fly at the hands of Army instructors, there is one consideration—a mechanical consideration though it be—which has a direct relation to those of us who are concerned with modern mechanical developments in their relation to ordnance. All of Colonel Lindbergh's courage and skill would have availed him little if the mechanics of his craft had been faulty. More than that, the successful execution of his renowned flight would have remained unfulfilled if his motor, the heart of the plane, had failed. But Lindbergh was confident that it wouldn't—and it didn't.

The design and development of aircraft motors—and especially aircraft—is a splendid tribute to the engineers and manufacturers of our aircraft industry. In less than a quarter of a century this mechanical marvel has evolved

to its present high state of performance. Continuous flight has grown in time from the 13 seconds of the first successful attempt of the Wright brothers at Kitty Hawk in 1902—just 25 years ago—to the 36 hours and 53 seconds of Lindbergh. The engineering skill reflected in such mechanical endurance is something to crow about.

On second thought, such progress is to a great degree indicative of the strides that have been made during the past decade in all the arts, including ordnance, ostensibly the deadest of them all. Development in radio communication has been hastened by its popular appeal; development in the entire field of electricity by its practical and utilitarian effects. Development in the automotive industry likewise has been stimulated by popular demand based on real usefulness.

In the piping days of peace who gives a whoop whether ordnance is progressing apace with the so-called peaceful arts? Ordnance, we are told, is on the shelf so long as all the bad boys in the family of nations behave themselves. But let one of the boys get unruly and even the short-haired ladies and long-haired men who go about preaching against preparedness are relieved to know that our powder is dry and our guns are not rusty.

For all its handicaps, ordnance has progressed in the past generation as have the other mechanical arts. Our guns and ammunition in many respects are as much an improvement over the old as the Ryan plane and Wright motor that thrust Lindbergh over the deep are better than the two-cylinder contrivance at Kitty Hawk. The rub is not that ordnance has not improved apace but that we haven't got enough of it. After all, we can develop the best ordnance this side of Mars but unless we actually have enough to do our job when the real job must be done, laboratory models and experimental types don't count for a great deal.

In this connection the Assistant Secretary of War, Col. Hanford MacNider, in an address before a joint meeting of the Boston Post, Army Ordnance Association, and the Massachusetts National Guard Association, held in Boston, Mass., May 26, 1927, made some very apt observations. As usual, Colonel MacNider didn't mince words. He said:

"All America, and, as far as that goes, all the world, is rejoicing in Lindbergh. His fellows in the National Guard and in the Reserve Corps—in the whole Army of the United States—are bursting with pride over his magnificent adventure. It puts the old snap into the step of every one of us to see young America come through and prove a new American generation to the world.

"Lindbergh's generation, just as every generation of Americans before it, stands ready and willing to serve. Lindbergh's two hundred thousand fellow-Guardsmen are giving of their time and energy that they may be trained for leadership in any emergency which may threaten our nation. Everyone of them is endeavoring to make himself a more useful citizen—an immediate asset to our country should danger befall her.

"Manpower is only half the problem of National Defense. We have no business calling men to the colors if we are not prepared to feed, clothe and shelter them. It is a far more serious thing to call them out if we cannot equip and arm them. The National Guardsmen will not be of much use if they are forced to march out to the nation's defense armed with broomsticks. It is true that they carry Springfields and we have rifles to replace them—Enfields, such as they are—ten years old. What is more, our supply of small arms ammunition would not last three months in a real emergency. It takes nearly a year to get into quantity production. We have cannon—"75s" left from the war. New ones already developed shoot nearly twice as far and as effectively. The American Army has six of them.

"How about ammunition? Perhaps a few months' supply—all nearly ten years old. It would take ten months to get into quantity production to make even our old "75s" useful.

"On articles which are not commercial, we must start from scratch. Take ordnance, for example, represented here by the Army Ordnance Association of Boston and by our District Ordnance Chief and staff. No manufacturer is building 75-mm. shells in time of peace, or anything that resembles them. It will take nearly a year, even with the most painstaking advance planning, to get into high on delivery of the finished article. War reserves must be set up and maintained if there is to be any semblance of national protection. We cannot buy time—once the emergency is upon us.

"Our Ordnance Department is made up of able men, supplemented by the active membership of the Army Ordnance Association. With limited means they have put up a good fight to maintain their part of the defense structure. Their activities are not as picturesque as those of the combat branches. For that reason they need your interest, help, and backing, to a greater degree than those spectacular military activities already sold through their traditional gallantry in action—by the printed page, the silver screen or from the bunting-draped platform on national holidays.

"Manpower was not our great problem in the World War. Five million men held up their right hands as fast as we could take them, and a lot faster than we could equip them. Most of our men, when they finally reached the front a year after our entry, carried rifles built for other armies. We had been manufacturing munitions for the Allies for three years. Even with that running start we could not meet our own requirements. The division with which I served fought the war with a sputtering, ineffective French automatic rifle and a foreign machine gun. Our American-made Brownings reached us the day after the Armistice.

"It took seventeen men behind the lines to make one man at the front an effective combat soldier. This proportion gives you some idea of the importance of supply in modern war. Seventeen interested citizens in every Congressional district could bring our present situation so forcibly to the attention of Congress that this unromantic, perhaps, but most necessary, defense requirement would receive proper attention.

"You of the National Guard should know the situation because you are asking men to entrust their lives under your command. In the Army Ordnance Association are the men who are struggling to meet the problem for you—sacrificing time and energy and giving of their hard-won experience in war and in Industry, to see that you are taken care of. We who know what happened in the late emergency must unite in our efforts if the bitterest lesson of the World War is not to be forgotten."

Professional

The Restabilization of Pyrocotton Deteriorated in Storage

FOR some time past nitrocellulose which had been manufactured during the war has been used at Picatinny Arsenal for the preparation of smokeless powder. This material at the time of manufacture (1917-18) was stable as judged by the 65.5° K. I. test and the 135° heat test. By the spring of 1924, however, some of this stored nitrocellulose had deteriorated to such an extent as to fail to pass both of these tests. Some means of restabilizing the nitrocellulose was needed before it could be used to make smokeless powder.

The most obvious method of purification was a water poaching treatment. This was tried and the stability improved sufficiently to pass the 135° heat test but not the more sensitive K. I. test. Continued poaching failed to bring this test up to the required 35 minutes. It therefore became necessary to work out a purification procedure in order to permit the use of this nitrocellulose for current manufacture of smokeless powder.

It was also considered highly desirable to explain the instability of such pyrocotton in order to minimize its development in the future.

A number of different poaching treatments were tried using sulphuric acid, nitric acid, and sodium carbonate at various dilutions in the first boil. Subsequent boils were made with distilled water. A K. I. test was made after each boil so as to follow the changes in stability. These experiments showed that the improvement in stability was greatest when the first boil was carried on in slightly acid solution and that the improvement noted after the first boil was not maintained by subsequent boils. Erratic results showing sometimes an increase and at other times a decrease in stability were obtained. Some of the nitrocellulose which after a number of boils gave the required 35 minute K. I. test showed a marked decrease after being boiled again.

To explain the action of the acids and the fact that the stability of the nitrocellulose could not be improved to give the test originally obtained, several facts need to be taken into consideration.

After storage the pyro upon analysis showed a sulphuric acid content of about 0.015 per cent. and a total sulphate (SO_4) content of about 0.03 per cent. It is well known that cellulose sulphate is readily hydrolyzed by boiling in a dilute acid solution. This is the reason for the so called "sour boil" in the boiling tub treatment for the purification of nitrocellulose.

It is therefore highly probable that in the course of time the original nitrocellulose, which gave a K. I. test of more than 60 minutes and still contained traces of sulphate, was gradually hydrolyzed liberating free sulphuric acid. The harmful effect of even traces of sulphuric acid on the stability of nitrocellulose has long been recognized. In connection with this work a test showed that the addition of 0.01 per cent. of sulphuric acid lowered the K. I. test by ten minutes.

Poaching with dilute acid therefore hydrolyzes the cellulose sulphate which is subsequently removed by water boilings or washes. Dilute alkalies have the same effect to a lesser degree. This elimination of sulphuric acid explains why the first boil, by any method used, raised the stability considerably. Although sulphuric acid was eliminated with the wash water after each boil there was no concomitant increase in stability. After the first decided increase produced by the first boil, additional boils sometimes lowered and sometimes raised the stability in an erratic manner.

Cellulose and its esters show a gradual deterioration with time. The rate of this deterioration depends upon storage conditions. As is well known deterioration may be retarded but not overcome. It has been established that the aging of nitrocellulose leads to a degradation of the complex molecule and that the rate of decomposition increases autocatalytically. This tendency to decomposition increases with time as well as with increasing temperature.

That some degradation of the nitrocellulose under discussion had taken place is shown by the fact that traces of tartaric acid were obtained in the wash waters. In addition a sample of deteriorated pyro which had been treated so as to give a K. I. test of 35 minutes, when heated with distilled water on the steam bath developed tartaric acid. This acid has been found by others as a decomposition product of nitrocellulose. The addition of 0.01 per cent. of tartaric acid lowered the K. I. test 11 minutes. The formation of tartaric acid is an indication of degradation and instability of the nitrocellulose under discussion and accounts for the inability to raise the K. I. test higher than about 40 minutes.

It may, therefore, be concluded that the *maximum* stability of nitrocellulose gradually decreases with time.

The method successfully adopted by Picatinny Arsenal for restabilizing deteriorated stored pyro was to poach the material with water containing about 0.12 per cent. of mixed acid and to follow this with a number of cold water washes until a K. I. test of the required 35 minutes was obtained. This procedure which has given repeatedly successful results is in accord with the explanation given above and should give the maximum stability obtainable.

H. AARONSON,
Picatinny Arsenal.

German Long Range Guns

THERE has been a great deal written since the World War on the subject of the German long range guns which fired on Paris in 1918, but the information has been derived from such varied sources that it has in each case been more or less fragmentary. This observation applies in part to the excellent account of the gun given in Vol. I, "Railway Artillery, Characteristic and Scope of Utility," prepared by the Office of the Chief of Ordnance.

The Paris Gun in Position

The gun is provided with a cable attachment, similar to that used in the construction of suspension bridges, for the prevention of sag in the barrel.

The following article published by the *Revue D'Artillerie* (French) November, 1926, is based upon a German press article which furnished information and photographs to supplement the accounts of these interesting weapons which had already appeared.

DESCRIPTION

The caliber chosen for these guns was 21 centimeters. After erosion, which occurred very rapidly,[1] the tube was rebored and again rifled to take a 24 centimeter projectile.

The gun was built from a 38 centimeter naval gun fitted with a 21 centimeter rifled tube and prolonged by a smoothbore extension, with the two parts united by a threaded joint. The total length was 34 meters,[2] which is about twice that of the 38 centimeter gun. The two tubes were assembled at the firing position.

The gun proper, or the non-demountable portion of the tube, which might be called the 38/21, traveled on a railway truck apparently identical with that used for the 38 centimeter gun. This carriage, of which the Allies captured an example, was supported on a total of 18 axles, 9 under each end.

The smoothbore extension was assembled to the gun proper with the aid of a gantry crane; following this a cable rigging similar to that used in suspension bridges was attached to the gun to prevent undue sag in the barrel. The straightness of the barrel was verified each time upon being reassembled.

The carriage was taken by rail to the emplacement. In the beginning, at the first position, near Crepy-en-Laonnois, the three emplacements used had been prepared some time in advance, one position being concreted, and the others being simply excavated to receive a metal ground platform providing a narrow field of fire. Afterwards the base employed was of a quick demountable all around traversing type, probably the same as that used for the 38 centimeter gun, one of which was captured by the French Army at Bois du Chatelet (10 km. north of Chateau-Thierry) following the offensive of July 18, 1918.

This base consisted of an annular ring of six parts for ease of transport, and carried a racer mounted on balls with 360 degrees traverse. A railroad track led diametrically through the position in such a way that the railway mount assembly could be pulled onto the ground platform. The mount was lowered into position by means of jacks. The trucks and track fastenings were removed, the turn-table was rotated a quarter turn and the carriage lowered and securely bolted in place.

The firing platform was furnished with a guard rail, and the personnel apparently remained in the emplacement during the firing.

The principal advantage of this system lay in the rapidity of emplacement, which consumed only a few hours,[3] provided the base ring had been previously installed. The all around traverse is of secondary interest, since the gun had a single objective; this feature was, however, made use of since it permitted the mounting of the gun at any azimuth, so that the approaching railway tracks could be laid in existing pathways, or alleys, in the forests, thus reducing the necessity for deforestation and aiding considerably in the camouflage of the position.

The projectile weighed 125 kilograms and the powder charge 200 kilograms, the powder chamber being more than 5 meters long. The muzzle velocity was about 1500 meters per second. With an elevation of 52 degrees the height of trajectory was 40 kilometers and the time of flight 3 minutes.

At each shot the gun was said to vibrate violently for about 2 minutes. By means of a special device the barrel was re-straightened each time before the firing of the next shot.

TERMINOLOGY

A few words of the German terminology. The long range guns, that is to say those firing at ranges in ex-

[1] Tubes were probably re-bored after about 50 rounds. (Trans.)

[2] Much longer than the French and British long range guns, which are, however, rifled throughout their length. (Trans.)

[3] In addition to time necessary for adjustment of barrel extension.

cess of 100 kilometers, were used solely for the bombardment of Paris. They were popularly called "Pariser Kanone" or "Parisgeschuetz." The official term is "Ferngeschuetz" for the gun and "Wilhelmrohr" for the tube.

The popular expressions "Bertha" or "Big Bertha" were never used in Germany in connection with the "Ferngeschuetz." The name "Dicke Bertha" was used in Germany throughout the War in connection with the 420-mm. mortar, which was so named because it was manufactured in the shops of Bertha Krupp of the famous Essen family of that name. The 420 was a short stocky weapon and would never be confused with the Paris gun by any German who had ever seen the latter, with its long needle-like appearance. The two German expressions "Dicke Bertha" and "Pariser Kanone" have only recently been linked together by the German press in eulogies on the occasion of the death of Rausenberger, the Krupp engineer, who "before the War supervised the construction of the 42 centimeter mortar (Dicke Bertha), and during the War, that of the Long Range Gun (Ferngeschuetz)."

Historical

Captain Kinzel of the German Navy, in his book *"Auf See Unbesiegt,"* consecrated to the glory of the German Fleet, has given many details on the long list of experimental projects which taxed the initiative of the Navy and which led to the production of the long range guns.

"Shortly after the beginning of trench warfare there was a desire to increase the range of the large naval guns, which then had a maximum range of 35 kilometers. We desired to shell Dunkerque, which was about 45 kilometers from our most advanced batteries in Flanders. Success was not long delayed: On April 28, 1915, 38 centimeter shells fell for the first time in Dunkerque—

"With some other particularly powerful guns,[4] we were in a position in 1917 to bring Saint-Omer and Doullens under fire. These important cities and railway junctions were at a range of 62 kilometers from the neighborhood of Cambrai.

"Our experiments gave us some happy surprises, especially in showing us the relation between maximum ordinate and range, using high angles of elevation. It began to appear as if we could do still better.

"The question then was, would the high command approve the expenditure of money, materials and labor for the construction of a gun with a range of 100 kilometers (our trenches were then, in 1916, about 90 kilometers from Paris). General Ludendorff, usually so cold in his communications, responded enthusiastically and urged us by all means to make the undertaking."

The author dwells on the difficulties of the task undertaken by the Department of Naval Artillery in collaboration with Krupp. It was necessary to double the muzzle velocity, accept pressures of 3,500 kilograms,[5] determine types of powder to use, the type of projectile—in fact to extend all the principles of ballistics and at the same time guard the secret. "The work had been in progress for nine months," he continues, "when the following brief telegram was received from Ludendorff, 'Please base your studies on a range of 120 kilometers instead of 100.' The explanation was obvious: the decision to retire to the Siegfried position had been made." Difficulties multiplied.

Captain Kinzel continues picturesquely with a description of the firing tests. The gun used was emplaced near the mouth of the Weser[6] and fired toward the north. Artillery observers were echelonned between the ranges of 40 and 120 kilometers. A range of 95 kilometers was attained that day. "Good distance, but not enough." The projectile was dug up and from its examination new perfections were undertaken. Kinzel reports that the shell struck in the middle of a herd of cows, but that "happily, none were hit."

The author concludes with a description of the first days of firing in position. Three guns were in battery in the neighborhood of Laon, camouflaged in the forest.[7] At 7:15 A. M. on March 22, 1918, the first shot was fired. Several 21 centimeter guns set up in the same area fired at the same time, in order to confuse the enemy locator sections. At 2:00 P. M. the sun came out, and the fire was suspended, to escape observation from French balloons. The Germans waited with impatience to learn whether Paris had been reached. The following morning firing was continued, although no one knew, as yet, where the first shots had struck. "A telephone call was soon received from Headquarters: 'The Parisian newspapers of this morning give accounts of the bombardment of the city by a powerful gun, the location of which is as yet unknown.' Our enthusiasm was short lived, for during our celebration a shell struck within 250 meters of our Headquarters in the middle of the Battery position, and a few minutes later, a second."

Captain Kinzel wonders "How the French were able to discover the exact location of our guns only 30 hours after our first shot, despite the ruse of firing all of the guns simultaneously. How could they get powerful artillery into proper position 25 kilometers away and open fire with such exactitude?" He concludes that the only explanation was, that the inhabitants of the neighborhood must have made known to the enemy that work had begun on the emplacements nine months previously. Kinzel could not believe that the French locating devices were capable of distinguishing between the guns firing from the same general direction, but some of them with a muzzle velocity of 1,500 meters and the remainder with muzzle velocities half as great.

Summary

The Germans, desirous in the early part of 1915 of shelling various French cities about 40 kilometers behind the front, employed naval guns on railway mounts for this purpose. The ranges attained exceeded their expectations, and led them to visions of longer ranges. Paris soon presented itself as an objective to the artillery leaders and to the German High Command. This led to the research which resulted, after two years of constant work, in the perfection of the famous long range gun.

T. R. Taber,
1st Lieut., Ord. Dept., U. S. A.

4Probably 52 calibre 35.5 cm. guns, partly constructed before the War, and having a range of 62 km. at 52 degrees.

5Doubtless an error. 35000 kg. is probably intended. (Trans.)

6Probably between Cuxhaven and Bremerhaven.

7The muzzles, however, protruded above the tree-tops with the guns elevated.

Death of Deport Recalls Long Secret Development of French 75-mm. Gun

THE recent death of Colonel Deport of the French Army, designer of the well-known French 75-mm. field gun, elicited the following comment from *The New York Times:*

"The death of Colonel Deport of the French Army, the inventor of France's famous '75' recalls the secrecy thrown around the final perfecting and distribution of this famous gun. Long before the World War rumors of a new French gun of superior merit spread beyond the Rhine. The French, it became known, had been making numerous tests with the Ducros gun, a weapon of 90-mm. bore and no brake. It was deduced by the German military staff that the Ducros gun would be adopted by the French Army, so they speedily began building their 77-mm. gun. When the test came in 1914 the German gun proved to be inferior to Deport's '75.'

"Colonel Deport was manager of the artillery shops at Puteaux when ordered to make an investigation of guns with automatic braking. He started his researches about thirty-seven years ago on an 80-mm. cannon with a hydropneumatic brake. By October, 1892, the work had progressed so far that it was possible to forecast the characteristics of the new device. It was to be fitted with a 'self-contained carriage, a breech with an eccentric screw, inclined planes to rest the cannon on the brake in passage.' The first gun was completed the following year and exhibited before a commission of military men. It was in a measure satisfactory, but changes were found necessary.

"By the time Colonel Deport left the service in 1894 the gun had been still further developed. It could fire 'twenty-five shells a minute, the shells weighing 15.4 pounds and having a muzzle velocity of 1,640 feet a second.' There were, however, limitations. The hydropneumatic braking, it was found, after a few shots exhausted its reserve of liquid and air so that the gun became inoperative. Therefore the weapon would prove useless under service conditions.

"Further development of the gun was placed in the hands of Captain Sainte Claire Deville, another army officer who for some years had been working on a rapid-fire gun of his own. Captain Deville's gun did not need 'any brake, and shot small projectiles at the rate of thirty-eight a minute and at a muzzle velocity of 1,870 feet.' This gun was eventually developed into a very useful weapon. After an investigation of the Deport gun, Captain Deville decided it merited an independent development, and for a time he abandoned his own invention. A new device to replace the original Deport brake was evolved and the first unit built fired 10,000 shots.

KEPT UNDER COVER TILL WAR

"In 1896 France decided to adopt the improved Deport gun as a standard weapon and to equip the army with it. This was carried out with the utmost secrecy and at an expenditure of 300,000,000 francs. Few persons knew of the success of the new gun, most of the information coming from army circles about it being most pessimistic. The mystery of the new '75' was preserved. The manufacture of its parts was not entrusted to one plant, but to various Government establishments.

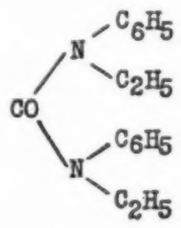
"Though manufactured in different places, these parts were interchangeable, through a development of 'design and methods of gaging and checking of high precision.' Only when the gun began to be delivered to artillery units through France in the World War did the public learn about the famous '75,' nicknamed by the American doughboy the 'whizbang.'"

Smokeless Powder Containing Centralite

MICHELE GIUA AND GUIDO GASTALLA

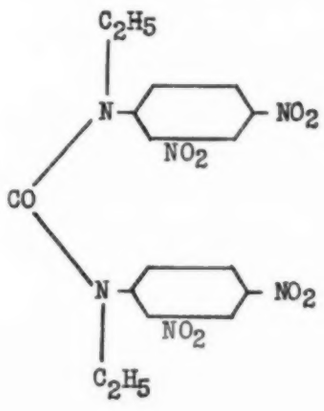
Translated from Atti della Reale Accad. delle Scienze di Torino [*vol.* 60, *pp.* 73-80, 1925] *by Commander Count Sommoti di Mombello, Former Naval Attaché, Italian Embassy, Washington, D. C.*

DURING the last few years, especially in Germany, the use of smokeless powders containing nitrocellulose, nitroglycerin and centralite has rapidly increased. This last substance corresponds to the symdiethyl-diphenyl-urea:



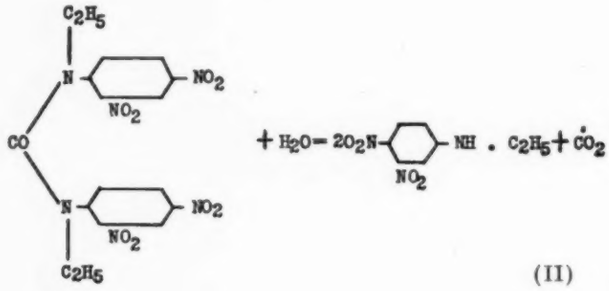
It is added to the mixture of nitrocellulose and nitroglycerin not only as a stabilizer but as a gelatinizer. The use of centralite in the manufacture of smokeless powders, introduced in Germany some years before the outbreak of the War, was kept secret: the gelatinizing properties of the centralite are so strong that one can decrease the quantity of solvents or even omit them entirely in the preparation of the *galetta*. This much simplifies the preparation of the powder. * * *

From the researches made by us on the action of fuming nitric acid on centralite, it was found that the molecule of this rather complex compound does not become greatly modified, at least under the conditions of our experiments. At the ordinary temperature, with the reagent indicated, a tetranitro derivative was obtained, which was found to be the 2, 4—2′, 4′—tetranitrodiethyldiphenylurea:



(I)

The chemical constitution of this new compound was determined through a very simple reaction. By treating the tetranitro derivative with concentrated sulphuric acid and warming it for a short time on a water bath, the reaction expressed by the following scheme is obtained with almost quantitative completeness:



(II)

Hence, the 2, 4—dinitroethylaniline, which has been obtained already in another way,[1] was obtained. The products of the reaction of nitrous acid with centralite are not very definite. Nitrous acid does not react with centralite dissolved in acetic acid, but it does react with a solution of the same substance in concentrated sulphuric acid giving rise to a beautiful red color[2]: when a current of nitrous vapors is passed over an ethereal solution of centralite, a yellow color, which changes into green, is obtained, but the product of the reaction is viscous, colored yellow, and shows no tendency to crystallize. An identical viscous product is obtained by treating the ethereal solution of centralite with hyponitrous acid.

Taking advantage of the colorimetric reaction of the centralite with nitrous vapors, we succeeded in finding a very simple method of determining whether or not a certain smokeless powder contains centralite. It is well known that concentrated sulphuric acid, at ordinary temperature saponifies the nitric esters, such as nitrocellulose and nitroglycerin, developing nitrous vapors. This reaction is more evident at a temperature of 30-40°. Now, treating the smokeless powder directly with concentrated sulphuric acid and warming up at 30-40° the grains of the powder rapidly become a raspberry-red color if centralite is present, and a little later the sulphuric acid also acquires the same color, while in the absence of centralite no coloring occurs.

This reaction may also be useful for the detection of other stabilizers such as diphenylamine. In such case we have the characteristic deep blue coloring obtained from the diphenylamine with nitrous and nitric acid.

Experimental

Nitration of centralite.

5 grams of centralite are added in small portions to 50 cc. of fuming nitric acid, shaken continuously and cooled with water. The liquid acid is colored a deep red. After a short time, on pouring the product into cool water an abundant yellowish mass is obtained, which when filtered by means of a pump and dried, weighs 8.5 grams. The product crystallizes from benzene and appears as pale-yellow colored needles which when exposed to light rapidly become reddish colored, especially when wet. It melts at 176-177°.

0.1527 grams of the substance gave 26.1 of N at 18° and 735 mm. of pressure:

Found 19.16 per cent. of N

For $C_{17}H_{16}O_9N_6$

Calculated 18.75 per cent. of N

The substance is easily soluble in benzene and acetone, slightly in alcohol, and but very slightly in ethyl ether and in petroleum ether.

Action of concentrated sulphuric acid on the product of nitration of centralite.

4 grams of tetranitrocentralite are dissolved in 50 cc. of cold concentrated sulphuric acid and the solution thus obtained, which is red colored, is warmed on the water bath for about 15 minutes. A development of gaseous bubbles occurs, which are easily recognized as carbon dioxide. After cooling, the liquid acid is poured into cool water and a yellow substance is obtained, which crystallizes from the alcohol in small yellow and bright flakes, which melt at 113-114°.

0.1696 grams of the substance gave 30 cc. of N at 16° and 744 mm. of pressure:

Found 20.18 per cent. of N

For $C_8H_9O_4N_3$

Calculated 19.91 per cent. of N

The substance corresponds in its properties to the 2, 4-dinitroethylaniline (form. II) already known: the reaction indicated above shows, beyond doubt, that the product of nitration of centralite should be indicated by formula (I).

Action of nitrous acid on the acetic solution of centralite.

2.5 grams of centralite, dissolved in 50 cc. of 70 per cent. acetic acid, are treated with 2.5 grams of sodium nitrite. No reaction occurs, while practically all of the nitrous vapors escape from the liquid. On dilution with water a whitish substance separates which is easily recognized as unaltered centralite.

Action of nitrous acid on the sulphuric solution of centralite.

2.5 grams of centralite, dissolved in 50 cc. of concentrated sulphuric acid, are treated with 2.5 grams of sodium nitrite and cooled with water. On adding the first portion of the nitrite, a deep red color is obtained. On pouring into water a resinous product, easily soluble in alcohol, is obtained. It has been studied no further.

Action of nitrous acid on the ethereal solution of centralite.

2.5 grams of centralite, dissolved in 50 cc. of ethyl ether, are submitted to the action of a strong current of nitrous vapors (from As_2O_3 and HNO_3 of sp. gr. 1.35). The green colored liquid produced gives, through evaporation, a viscous residuum which does not show any tendency to crystallize.

Action of hyponitrous acid on the ethereal solution of centralite.

2.5 grams of centralite, dissolved in 50 cc. of ethyl ether,

1Romburgh "Rec. trav. chim." 2,104; Norton e Allen "Ber. chem. Gesell." 18,1998; Hempel "J. prakt. Chem." (2), 39,199.

2Recently L. Desvergnes ("Ann. chim. anal. chim. appl." 1924, pag. 102) has recommended the use of sym-diethyl-diphenyl-urea for the detection of nitric and nitrous acids.

are treated with 10 cc. of hyponitrous acid. A lively reaction results accompanied by a remarkable development of heat, while the ethereal liquid becomes colored green growing gradually deeper colored. Evaporting until dry a viscous residuum like the above mentioned one is obtained.

Qualitative research of centralite in smokeless powders.

About 0.2-0.3 grams of powder are treated in a test tube with 5-10 cc. of concentrated sulphuric acid: the tube is warmed for a few minutes in a water bath at 30-40°; in the presence of centralite a raspberry red coloring is obtained.

Quantitative research.

When it is necessary to determine quantitatively each component of a powder containing nitrocellulose, nitroglycerin and centralite, the procedure is the following:

About 5 grams of powder (precisely weighed) are extracted with anhydrous ether in the ordinary way with the Soxhlet apparatus: the ethereal liquid, evaporated till dry at constant weight,[1] represents the quantity of nitroglycerin + centralite contained in the powder. The insoluble part represents the nitrocellulose, which is therefore determined by difference.

Not being able to determine the nitroglycerin in the residuum of the ethereal extract by means of the Lunge nitrometer, because the presence of centralite gives results much below the truth, owing to its absorption of a remarkable quantity of nitrous vapors,[2] we proceed to the determination of the nitrogen by the Dumas method on a part of the residuum from the ethereal extract (about 0.15 grams). This must be limpid and must not show crystals of centralite in suspension; otherwise it is necessary to warm it up slowly so as to obtain a homogeneous liquid.

From the weight of the nitrogen obtained (which represents the nitrogen contained in the analyzed part of the nitroglycerin + centralite mixture), we arrive at the quantity of the two components by the following calculation:

Let M represent the total weight of the nitroglycerin-centralite mixture obtained from a weight L of powder: then let N represent the weight of nitrogen obtained from a weight P of the ethereal extract. As the nitroglycerin contains 18.5 per cent. of nitrogen and the centralite contains 10.4 per cent. of it, indicating by x the quantity of nitroglycerin, and by y the quantity of centralite contained in the portion of the mixture on which the nitrogen has been determined, we obtain the following equations:

$$x + y = P;$$
$$0.185\,x + 0.104y = N$$

from which we have:

$$x = \frac{N - 0.104\,P}{0.081}$$
$$y = \frac{0.185\,P - N}{0.081}$$

By simple proportions we arrive at the quantities of nitroglycerin and centralite contained in the total quantity (M) of the ethereal extract, and therefore also in the quantity (L), of powder which served for the analysis. By other proportions we calculate the percentages of these substances in the powder under examination. Calling respectively alpha and beta the percentages of nitroglycerin and centralite, we obtain:

$$\alpha = \frac{100\,x\,M}{L\,P};\quad \beta = \frac{100\,y\,M}{L\,P}$$

Examples: (1) From 5.0027 grms. of powder, 2.6129 grms. of nitroglycerin + centralite were obtained by extraction. On making on 0.1013 grms. of such a mixture a determination of nitrogen (according to Dumas), 0.01805 grms. of nitrogen were obtained.

By means of the foregoing formulas we calculated the quantities of nitroglycerin (0.0928 grms.) and of centralite (0.0085 grms.) in the analyzed part; from this we proceeded to the percentages of the two components in the analyzed powder, obtaining 47.84 per cent of nitroglycerin, 4.38 per cent. of centralite. The percentage of nitrocellulose, calculated by difference, is 47.78 per cent.

(2) From 5.0157 grms. of powder, 2.6188 grms. of nitroglycerin + centralite were obtained by extraction. On making on 0.1404 grms. of such mixture a determination of nitrogen (according to Dumas) 0.024934 grms. of nitrogen were obtained. By means of the foregoing formulas we calculated the quantities of nitroglycerin (0.12756 grms.) and of centralite (0.01284 grms.) in the analyzed part: from this we proceeded to the percentages of the two components in the analyzed powder, obtaining the following results: 47.43 per cent. of nitroglycerin, 4.77 per cent. of centralite. The percentage of nitrocellulose, calculated by difference is 47.80 per cent.

	Data found I	Data found II	Actual composition of the powder
Nitroglycerin	47.84	47.43	47.50 Per cent.
Centralite	4.38	4.77	5.00 Per cent.
Nitrocellulose	47.78	47.80	47.40 Per cent.

From the percentage of nitrogen of the nitroglycerin + centralite mixture the approximate quantity of the two components can be obtained also graphically, by the system of the Cartesian coordinates in which the abscissas represent the percentage concentrations increasing in nitroglycerin, and the ordinates the percentages of nitrogen. The straight line which unites the point 10.4 corresponding to 100 per cent of centralite to point 18.5 corresponding to 100 per cent of nitroglycerin, will represent all the mixtures (from 0 to 100) of the two components.

This number of ARMY ORDNANCE *completes Volume VII. An index to Volume VII, arranged by subject and author, is mailed with this issue to all members and subscribers.*

1See M. Giua, Chimica delle sostanze esplosives, pag. 486.

2It is to be noted that the absorption of nitrogen oxides on the part of the centralite does not occur during the decomposition of the nitroglycerin in the nitrometer, but before introducing the sulphuric solution of the nitroglycerin-centralite mixture into the nitrometer bulb. In fact the sulphuric solution is colored deep red, which indicates that the reaction of absorption on the part of the centralite has occurred. This is easily explained when one recalls that concentrated sulphuric acid also partially saponifies the nitroglycerin when cold.

Personnel

Philadelphia Post Meeting

A MEETING of the Philadelphia Post, Army Ordnance Association, was held on Tuesday evening, May 3, 1927. Forty-five members of the Post, with guests, sat down to dinner in the Engineers' Club, 1317 Spruce Street, Philadelphia, at 6 P. M. Following dinner the group adjourned to the auditorium of the Engineers' Club where thirty more members were already assembled.

The meeting was opened at 7:30 by President J. Q. MacDonald. The minutes of the previous meeting, held on March 15, 1927, were read and approved. Captain F. C. Shaffer, Treasurer of the Post, was called on by the President to describe briefly the trip to the Military Academy at West Point in which the Philadelphia Post had been invited to participate by the Metropolitan Section of the Engineering Societies at New York City. Approximately twenty persons signified their intention of taking the trip and the President instructed Captain Shaffer to see that a descriptive circular was sent to each member of the Philadelphia Post.

President MacDonald then introduced Major H. R. Kutz, Ord. Dept., U. S. A., Ordnance Officer, Third Corp Area. Major Kutz gave a short talk in which he emphasized the dependence of the field section of the Ordnance Department upon the manufacturing section and he expressed great pleasure at being able to be with a part of the manufacturing group for a short visit.

President MacDonald then called on Captain F. C. Shaffer, Treasurer of the Post, to introduce Mr. G. Burling Jarrett of 210 Westmont Avenue, Haddonfield, N. J. Captain Shaffer outlined the work of Mr. Jarrett in getting together one of the most important collections of World War small arms that had ever been attempted. Mr. Jarrett then described a little more fully the nature of his collection and concluded by inviting the members of the Post to visit his home on May 28 for the purpose of seeing this collection of small arms. President MacDonald directed that an announcement of the trip be mailed to each member of the Philadelphia Post.

This meeting having been designated as the annual meeting of the Philadelphia Post, election of officers for the ensuing year was then held with the following results: President, Major Joseph A. Steinmetz, Ordnance Reserve, of the Janney-Steinmetz Company, Philadelphia; Vice-President, Lieut. Col. Archibald B. Hubard, Ordnance Reserve, of the Globe Ticket Company, Philadelphia; Secretary, Lieut. T. R. Snyder, Ordnance Reserve, Department of Labor and Industry, Commonwealth of Pennsylvania, Harrisburg; Treasurer, Captain F. C. Shaffer, Ordnance Department, Executive Assistant, Philadelphia District Ordnance Office. Three new Directors were elected to succeed Messrs. Steinmetz, Tryon and Longstreth whose terms expired. The new Directors were elected for a period of two years. They are as follows: Major John Q. MacDonald, Ordnance Department, Frankford Arsenal, retiring President of the Post; Captain R. W. Bond, Ordnance Reserve, Modern Bond Company, Wilmington, Delaware; and Mr. J. L. Poultney, of the J. G. Brill Company, Philadelphia. They, together with Mr. Samuel Shoemaker, Mr. J. W. Robbins and Col. E. M. Chance, will constitute the Board of Directors for the ensuing year.

Following several entertainment features five reels of motion pictures depicting the mining and working of copper in all its phases were shown through the courtesy of the American Brass Company.

Major R. A. Bull to Receive Joseph S. Seaman Gold Medal

THE Board of Directors of the American Foundrymen's Association, acting upon the recommendation of the Board of Awards, has unanimously voted to award to Major Robert Alexander Bull, a charter member of the Army Ordnance Association, the Joseph S. Seaman Gold Medal of the American Foundrymen's Association, in recognition of his services to the Association and to the foundry industry.

Maj. R. A. Bull.

Major Bull was born in New Albany, Ind., on June 28, 1874. He was a student at Depauw College and later at Butler University, where he was graduated with the degree of B. A. He later received the degree of M. A. from St. Louis University.

Maj. Bull has held positions of importance with the Leighton & Howard Steel Co., East St. Louis, the American Steel Foundries, the Commonwealth Steel Co., the Chicago Steel Foundry Co., and the Duquesne Steel Foundry Co., being vice-president and general manager for the last two concerns. He was commissioned a major in the Ordnance Department, U. S. Army, and served in the Division of Construction and Maintenance of the A. E. F.

Major Bull, a past president and honorary member of American Foundrymen's Association, has long been

prominently identified with the steel foundry industry. Since its organization he has been Research Director of the Electric Steel Founders' Research Group. In this position he has been instrumental in directing successful research investigations of vital importance to the industry and has generously contributed information to the foundry world through papers presented before the American Foundrymen's Association and to the technical press.

Joining the American Foundrymen's Association in 1907, he immediately took an active interest, was elected district vice-president in 1911, first vice-president in 1914, elected president for the year 1915, re-elected for the year 1916, and served as a director from 1917 to 1925. It was during the years of Major Bull's presidency that the Association went through a reorganization period, became an incorporated body, and took over the management of exhibits.

In addition to contributing papers of a technical character Major Bull has served as a member and chairman of many important committees. It was largely through his efforts as the first chairman of the Joint Committee on Molding Sand Research that this work was so successfully launched, resulting in developing methods of sand test and making geological surveys of foundry sand resources.

Ordnance Course for Reserve Officers at Stanford University

By 1st Lieut. Boynton M. Green, Ord. Res.

A FIFTEEN day training period for Ordnance Reserve Officers of the Ninth Corps Area was held at Stanford University from February 6th to 20th, 1927. A four-page leaflet was issued by the School of Engineering giving information concerning the course, a list of the instructing staff, schedule to be followed, and maps of the campus and buildings. To quote from it: "Training of officers holding commissions in the Ordnance Reserve may be regarded as an endeavor to carry out the purpose of the University. This year's instruction to officers is due to the efforts of Dean Theodore J. Hoover, officers of the Ninth Corps Area, and the San Francisco District Ordnance Office. President Ray Lyman Wilbur, of Stanford University, and Maj. Gen. C. C. Williams, Chief of Ordnance, U. S. A., have approved and given their support to the plan. The School of Engineering, under whose auspices the fifteen days of training are given, is composed of the following integral units: civil engineering, electrical engineering, mechanical engineering, military science and tactics, and mining and metallurgical engineering. Military instruction at Stanford is optional with physical training, as the University requires six units of either. The training consists of a two-year basic course in Field Artillery followed by a two-year advanced course in Field Artillery or Ordnance."

Seventeen reserve officers and one officer of the regular army reported for duty, including three reserve officers on the faculty of the University. These were quartered for the most part in the various hotels in Palo Alto with three officers living on the campus and two commuting from San Francisco, an hour's distance by train.

The following program of work, taken from the leaflet, summarizes the course of instruction:

Time Schedule

Hour	Day	Instructor	Subject
		FIRST WEEK (Feb. 7-12)	
8:00	M.	Atwood	Preliminary Address
8:00	T. W. Th. F.	Domonoske	Mechanical Engineering Applied to Production of Shells
9:00	M. W. F.	Quinn	Chemistry of Explosives
9:00	T. Th.	Keliher	Military Law
10:00	T. W. Th. F.	Crook	Ordnance Steels
10:00	M.	Domonoske	Mechanical Engineering Applied to Production of Shells
11:00	M. T. Th.	Hoover	Human Relations to Mineral Supplies
11:00	W.	Cornwall	Ordnance Department
11:00	F.	Brett	Procurement
9-10:30	S.	Geary	Pistol Practice
		SECOND WEEK (Feb. 14-19)	
8:00	M. T. W. Th. F.	Moser	Ordnance Engineering
9:00	M. W. F.	Quinn	Chemistry of Explosives
9:00	T. Th.	Keliher	Military Law
10:00	M. T. W. Th. F.	Taylor	Law of Contracts with Special Reference Proposed War Contracts
11:00	M. T. W. Th. F.	Blichfeldt	Numerical Integration
11:00	M. T. W. Th. F.	Domonoske	Special Instruction for Officers Who Have Not Studied Calculus
9-10:30	S.	Geary	Pistol Practice

Laboratory Sections

1:30-4:30 M. T. W. Th. F. both weeks
Ordnance Metallurgy, Crook
Mechanical Engineering, Domonoske and Green
Chemistry of Explosives, Quinn

Upon arrival on Sunday, February sixth, the officers reported to Maj. W. D. Geary, Commandant of the Field Artillery, R. O. T. C. Unit, and then to Capt. A. B. Domonoske, Ord. Res., Head of the Mechanical Engineering Department, for enrolment and assignment for physical examination. Then followed an inspection of the campus to locate the various lecture rooms.

Work began at 8:00 A. M. Monday with an introductory talk by Capt. F. J. Atwood, in charge of the Stanford Ordnance Unit. Following this came the first of six lectures on the chemistry of explosives by Prof. E. L. Quinn, and so on. All members of the class attended the morning lectures.

The lectures on mechanical engineering applied to the production of shells, by Captain Domonoske, covered the various methods of producing shell bodies with a detailed study of hot forging in hydraulic presses, stresses in the shell, and design of dies. This information was used later by the laboratory section in mechanical engineering.

Under chemistry of explosives Professor Quinn gave a very interesting series of talks on the composition and preparation of explosives with demonstrations for some of the principal compounds.

Major Keliher, of the Stanford Field Artillery Unit, covered military law in a very comprehensive manner, using the Manual of Courts Martial as a reference book. He discussed the various classes of military court, their organization and jurisdiction, the preparation of charges, and the handling of witnesses.

The subject of ordnance steels was handled by Prof. W. J. Crook, who explained the need for special steels and discussed their chemical and physical characteristics and uses.

Dean T. J. Hoover of the School of Engineering gave three excellent talks, entitled Human Relations to Min-

eral Supplies, in which he showed the steps in the use of stone and metals by human beings and how such use has affected civilization.

The class was very fortunate in having an opportunity to hear Col. Bruce Cornwall, Ord. Res., Chief of the San Francisco Ordnance District, on the general ordnance problem, what difficulties the Department experienced during the last war, and how it is hoped to avoid them in the future.

Maj. M. L. Brett, Executive Assistant of the San Francisco District, discussed the district procurement program, touching on the principal items to be furnished by this district and how it is planned to obtain them.

A refresher course in mechanics of materials under the heading of ordnance engineering, was given by Prof. Charles Moser. In the short allowance of five lectures he discussed the main points concerning stresses in tension, compression and flexure, hoop stresses, helical springs, and the principal stresses and reactions in gun carriages and platforms.

Student Officers and Instructors, Ordnance Reserve Officers Training Course, Stanford University

Sitting (left to right): Capt. Domonoske, Lt. Anderson, Lt. Radcliffe, Lt. Cory, Lt. Chippendale, Lt. Hart, Capt. Doble, Major Brett.
Standing (left to right): Major Crook, Capt. Miller, Lt. Green, Lt. Faulkner, Capt. Robinson, Capt. Tickell, Major Geary, Capt. Ridgeway, Major Hayes, Lt. Col. T. J. Hoover, (Lt. Vendley directly above Col. Hoover), Capt. Denn, Capt. Atwood, Prof. Quinn, Major Benson, Prof. Blichfeldt, Lt. Blocksom, Lt. Currier, Major Spalding.

Five lectures by Prof. J. D. Taylor, of the Stanford Law School, were devoted to the law of contracts with special reference to proposed war contracts. He furnished the class with a very valuable syllabus which included the principal items in the present War Department contract and a discussion of their applications and limitations.

Prof. H. F. Blichfeldt gave a series of lectures on the methods employed in numerical integration. As this method is largely used in the solution of problems in ballistics it is of special interest to the Ordnance officer. For those officers who had not studied calculus and therefore could not have derived the full benefit from the course in numerical integration, Captain Domonoske gave five lectures on elementary calculus, developing the subject as far as was possible in that short time.

A very interesting feature was a series of two lectures on the various methods of nitrogen fixation by Maj. H. K. Benson, Ord. Res., of the University of Washington, one of the student officers. He called attention to the indispensibility of large quantities of fixed nitrogen in time of war and give a very clear account of the processes and apparatus that have been developed for this important function.

For afternoon laboratory work the class was divided into three sections, the officers electing to work in either chemistry of explosives, mechanical engineering, or ordnance metallurgy. Those choosing chemistry of explosives worked under Professor Quinn in the Chemistry Department, going more into detail in the methods of producing the various war explosives. The engineering group, under the guidance of Captain Domonoske and Lieutenant Green, took up the design of an hydraulic forging plant for the production of 5,000 rounds of 75-mm. high explosive shell per day, which is the allotment to the San Francisco Ordnance District. This was a very practical problem as there is at present no plant on the Pacific Coast available to the Ordnance Department for this assignment and in the case of a major emergency one would have to be constructed. The group of officers was divided into several sections lead by experienced members; one group working on the forging presses, another on the heating furnaces, a third on the building, and a fourth group worked on pumps, accumulators, etc. Good progress was made by all sections. At the end of the two weeks each was able to show a preliminary layout of its problem and several sections had some detail drawings to their credit. It is planned to continue these designs until a set of well studied drawings is developed for the use of the District. The afternoon section in ordnance metallurgy worked in the laboratory under Professor Crook on the analysis and testing of ordnance steels, receiving training in the use of the metallograph, the preparation, polishing, and etching of specimens for microscopic study, microphotographic methods, chemical analysis, etc.

By way of diversion Saturday mornings were devoted to practice on the outdoor range with the automatic pistol under the able tutelage of Major Geary, and several fair scores were made.

Another interesting incident was an evening demonstration in the new Ryan High Voltage Laboratory which has just been placed in operation. Here it is possible to develop 2,100,000 volts, single phase, and the result is evidenced in the production of a spark twenty feet long.

One evening the class met for dinner in San Francisco and later attended one of a series of lectures on Ammunition and Explosives which Major S. P. Spalding, Corps Area Ordnance Office, has been giving throughout the winter for the benefit of reserve officers who are taking correspondence courses.

It is obvious that this course was in no sense an easy one; work was the order of the day. Most of the instructors assigned work to be done outside of class in preparation for the next lecture, either reading or prob-

lems, and all this had to be fitted in after 4:30 or in the evening. It is expected that a similar training course will be made part of the regular yearly activities of the San Francisco Ordnance District.

The following officers were on duty during the school: Capt. L. A. Miller, Ord. Dept., U. S. A., detailed to the Caterpillar Tractor Plant; Maj. H. K. Benson, Seattle, Washington; Capt. J. A. Denn, Roseburg, Oregon; Capt. W. A. Doble, Berkeley, California; Capt. A. B. Domonoske, Stanford University, California; Capt. G. H. Ridgeway, Reno, Nevada; Capt. W. E. Robinson, Long Beach, California, Capt. F. G. Tickell, Palo Alto, California; 1st Lieut. B. M. Green, Palo Alto, California; 2nd Lieut. L. A. Anderson, San Francisco, California; 2nd Lieut. F. C. Blocksom, Berkeley, California; 2nd Lieut. Henry Chippendale, San Francisco, California; 2nd Lieut. R. L. Cory, Oceanside, California; 2nd Lieut. C. R. Currier, Oakland, California; 2nd Lieut. J. H. Faulkner, Seattle, Washington; 2nd Lieut. L. H. Hart, Butte, Montana; 2nd Lieut. T. D. Radcliffe, Oakland, California; 2nd Lieut. C. E. Vendley, Los Angeles, California.

W. Kesley Schoepf

MR. W. KESLEY SCHOEPF, a member of the Advisory Board, Cincinnati Ordnance District, died May 7, 1927.

Mr. Schoepf was president of the Cincinnati Car Company. He relinquished the presidency of the Cincinnati Street Railway Company several years ago. He was a leader in street railway and traction work in the state of Ohio. His death is a great loss to his associates of the Cincinnati Ordnance District.

Major Maxwell Addresses Reserve Officers

MAJ. R. L. MAXWELL, Ord. Dept., U. S. A., Ordnance Officer, 1st Cavalry Division, Fort Bliss, Texas, addressed the El Paso Chapter of the Reserve Officers Association at its regular meeting on May 3, 1927.

Major Maxwell's talk covered the general subject of the mission, organization and activities of the Ordnance Department particular emphasis being placed upon the development of news items and improvement of adopted standards.

The talk was well received and was followed by a general discussion during which many questions were asked and answered showing the varied interests of the members of the El Paso Chapter.

At the close of the session Major Maxwell, who is also Post Ordnance Officer at Fort Bliss, invited Colonel Jamieson, President of the Chapter, to set a date for all members of his organization to visit Fort Bliss and inspect the Ordnance installations and activities of that post.

Summer Training Camps for Ordnance Reserve Officers

AS in former years, two training camps will be held for Ordnance Reserve Officers during the summer of 1927. The camp at Rock Island Arsenal will be held from July 10th to July 23rd, inclusive, and the course at Aberdeen Proving Ground will be held from July 31st to August 13th, inclusive. At both camps the basic course for Ordnance Reserve Officers will be given.

All members of the Ordnance Reserve Corps, Branch Assignment Group, were notified in the spring as to the requirements for applying for summer training, and indications are that camps with instruction facilities for the same number of men as have been trained in former years will be held at both establishments. Reserve Officers designated for summer training will be notified in good time by the Office of the Chief of Ordnance.

Ordnance Reserve Officers Attend Spring Training

TRAINING courses for Ordnance Reserve Officers were conducted at the various manufacturing arsenals, field service depots, and the district ordnance offices during the past spring. The establishments at which the courses were given and the reserve officers, with their assignments, who took the various courses follow:

At Watertown Arsenal:

Maj. Louis A. Daerr, Ord. Res., Manufacturing Service, Chicago District Ordnance Office,

Maj. Albert W. Draves, Ord. Res., Manufacturing Service, Chicago District Ordnance Office,

Maj. George E. Knable, Ord. Res., Manufacturing Service, Pittsburgh District Ordnance Office,

Maj. Elmer E. Snare, Ord. Res., Manufacturing Service, Chicago District Ordnance Office,

Capt. Roswell J. Clapp, Ord. Res., Manufacturing Service, Bridgeport District Ordnance Office,

Capt. Howard Logan, Ord. Res., Manufacturing Service, Watertown Arsenal,

Capt. George J. Schladt, Ord. Res., Manufacturing Service, Picatinny Arsenal,

Capt. Lindley G. Schmidt, Ord. Res., Field Service, Maintenance Division, Washington, D. C.,

Capt. Floyd L. Strawn, Ord. Res., Manufacturing Service, Artillery Division, Washington, D. C.,

Capt. Granville E. Webster, Ord. Res., Manufacturing Service, New York District Ordnance Office,

Capt. Claude W. Wright, Ord. Res., Manufacturing Service, Bridgeport District Ordnance Office,

1st Lieut. Floyd M. Bevins, Ord. Res., Manufacturing Service, Detroit District Ordnance Office,

1st Lieut. Thomas E. James, Ord. Res., Manufacturing Service, Picatinny Arsenal,

1st Lieut. Tracy C. Kerr, Ord. Res., Manufacturing Service, Bridgeport District Ordnance Office,

1st Lieut. Douglas L. Rehlaender, Ord. Res., Manufacturing Service, Buffalo District Ordnance Office,

1st Lieut. Carlyle H. Strand, Ord. Res., Manufacturing Service, Watertown Arsenal,

2nd Lieut. Donald R. Biron, Ord. Res., Manufacturing Service, Bridgeport District Ordnance Office,

2nd Lieut. Wayne L. Cockrell, Ord. Res., Manufacturing Service, Philadelphia District Ordnance Office,

2nd Lieut. Ralph L. Coryell, Ord. Res., Manufacturing Service, Detroit District Ordnance Office,

2nd Lieut. Charles E. Geisler, Ord. Res., Manufacturing Service, Boston District Ordnance Office,

2nd Lieut. Kelsey H. Jewett, Ord. Res., Manufacturing Service, Buffalo District Ordnance Office,

2nd Lieut. Antonio A. Lauria, Ord. Res., Manufacturing Service, Boston District Ordnance Office,

2nd Lieut. George E. Mason, Ord. Res., Manufacturing Service, Boston District Ordnance Office.

At Picatinny and Frankford Arsenals:

2nd Lieut. Carl W. Horack, Ord. Res., Manufacturing Service, San Francisco District Ordnance Office.

At Picatinny Arsenal:

Maj. James F. Carle, Ord. Res., Manufacturing Service, U. S. Nitrate Plant,

Capt. Walter Arthur, Ord. Res., Manufacturing Service, Frankford Arsenal,

Capt. Frank C. Locke, Ord. Res., Manufacturing Service, New York District Ordnance Office,

Capt. George A. Sherron, Ord. Res., Manufacturing Service, Philadelphia District Ordnance Office,

1st Lieut. William L. Allison, Ord. Res., Technical Staff, Washington, D. C.,

1st Lieut. Hiram B. Channon, Ord. Res., Manufacturing Service, Boston District Ordnance Office,

1st Lieut. Seth Wiard, Ord. Res., Manufacturing Service, Bridgeport District Ordnance Office,

2nd Lieut. John H. Brown, Jr., Ord. Res., Manufacturing Service, Cincinnati District Ordnance Office,

2nd Lieut. Arthur B. Hansen, Ord. Res., Field Service, Ammunition Supply Division, Washington, D. C.

At San Francisco District Ordnance Office and Benicia Arsenal:

Maj. Almon W. Copley, Ord. Res., Manufacturing Service, San Francisco District Ordnance Office,

Maj. Albert A. Hedge, Ord. Res., Manufacturing Service, San Francisco District Ordnance Office,

Maj. James Spiers, Ord. Res., Manufacturing Service, San Francisco District Ordnance Office,

Capt. Ralph O. Cragin, Ord. Res., Manufacturing Service, San Francisco District Ordnance Office,

Capt. William M. Moody, Ord. Res., Manufacturing Service, San Francisco District Ordnance Office,

1st Lieut. Carroll D. Hudson, Ord. Res., Manufacturing Service, San Francisco District Ordnance Office,

1st Lieut. Herbert L. McCaleb, Ord. Res., Manufacturing Service, San Francisco District Ordnance Office,

1st Lieut. Howard P. Witten, Ord. Res., Manufacturing Service, San Francisco District Ordnance Office,

2nd Lieut. Hiram E. Cassidy, Ord. Res., Manufacturing Service, San Francisco District Ordnance Office,

2nd Lieut. Howard M. Josephs, Ord. Res., Manufacturing Service, San Francisco District Ordnance Office,

2nd Lieut. Clarence L. Peterson, Ord. Res., Manufacturing Service, San Francisco District Ordnance Office,

2nd Lieut. Howard S. Taylor, Ord. Res., Manufacturing Service, San Francisco District Ordnance Office.

At Washington, D. C., and Picatinny Arsenal:

Maj. Clark S. Robinson, Ord. Res., Manufacturing Service, Ammunition Division, Washington, D. C.

At Washington, D. C., and Raritan Arsenal:

1st Lieut. John D. Frost, Ord. Res., Manufacturing Service, Rock Island Arsenal,

1st Lieut. William Kendall, Ord. Res., Manufacturing Service, Rock Island Arsenal.

At Washington, D. C.:

Col. James F. Monaghan, Ord. Res., Field Service, Facilities Section, Washington, D. C.,

Lieut. Col. Harry A. Knox, Ord. Res., Manufacturing Service, Tank, Tractor, and Trailer Division, Washington, D. C.,

Maj. Aldridge E. Hunt, Ord. Res., Manufacturing Service, Small Arms Division, Washington, D. C.

At Cincinnati District Ordnance Office:

Lieut. Col. Walter A. Dibble, Manufacturing Service, Cincinnati District Ordnance Office,

1st Lieut. Alfred F. Witte, Manufacturing Service, Cincinnati District Ordnance Office.

At Savannah Ord. Res. Depot:

Capt. Maxwell F. Barnes, Ord. Res., Field Service, Ammunition Supply Division, Washington, D. C.

At Frankford Arsenal:

Lieut. Col. Frederick E. Wright, Ord. Res., Manufacturing Service, Artillery Division, Washington, D. C.,

Maj. John C. Gray, Ord. Res., Technical Staff, Washington, D. C.,

Maj. Colin E. McRae, Ord. Res., Administration Division, Finance Contact Section, Washington, D. C.,

Maj. John S. Spicer, Ord. Res., Manufacturing Service, Frankford Arsenal,

Capt. J. LeRoy Delany, Ord. Res., Manufacturing Service, Artillery Division, Washington, D. C.,

Capt. Vladimir V. de Sveshnikoff, Ord. Res., Manufacturing Service, Small Arms Division, Washington, D. C.,

Capt. Howard L. Fairlamb, Ord. Res., Technical Staff, Aberdeen Proving Ground,

Capt. Harry B. Hambleton, Ord. Res., Manufacturing Service, Executive Section, Washington, D. C.,

Capt. Charles B. Mellen, Ord. Res., Manufacturing Service, New York District Ordnance Office,

1st Lieut. Levi C. Eddy, Ord. Res., Manufacturing Service, Chicago District Ordnance Office,

1st Lieut Kenneth C. Monroe, Ord. Res., Manufacturing Service, Bridgeport District Ordnance Office,

1st Lieut. Earl Naramore, Ord. Res., Manufacturing Service, Bridgeport District Ordnance Office.

1st Lieut. Jay E. Rohrer, Ord. Res., Manufacturing Service, Birmingham District Ordnance Office,

1st Lieut. Gilbert I. Ross, Ord. Res., Manufacturing Service, Bridgeport District Ordnance Office,

2nd Lieut. Lee C. Bennett, Ord. Res., Manufacturing Service, Buffalo District Ordnance Office,

2nd Lieut. Lloyd Colston, Ord. Res., Manufacturing Service, Buffalo District Ordnance Office,

2nd Lieut. Thomas L. Hapgood, Ord. Res., Manufacturing Service, Bridgeport District Ordnance Office,

2nd Lieut. Alfred W. Nagel, Ord. Res., Manufacturing Service, Birmingham District Ordnance Office,

2nd Lieut Patrick C. O'Shee, Ord. Res., Manufacturing Service, Birmingham District Ordnance Office,

2nd Lieut. Frank H. Smith, Jr., Ord. Res., Manufacturing Service, Birmingham District Ordnance Office.

At Springfield Armory:

Maj. Louis B. Runk, Ord. Res., Manufacturing Service, Philadelphia District Ordnance Office,

Capt. Milford H. Clark, Jr., Ord. Res., Manufacturing Service, Buffalo District Ordnance Office,
Capt. Henry H. Olmstead, Ord. Res., Manufacturing Service, Picatinny Arsenal,
Capt. Silas Williams, Ord. Res., Manufacturing Service, Bridgeport District Ordnance Office,
Capt. Clyde R. Yates, Ord. Res., Manufacturing Service, Bridgeport District Ordnance Office,
Capt. Frank A. Young, Ord. Res., Manufacturing Service, Bridgeport District Ordnance Office,
1st Lieut. Alfred G. Glode, Ord. Res., Manufacturing Service, Bridgeport District Ordnance Office.

Office of the Assistant Secretary of War, Washington, D. C.:

Lieut. Col. Jeremiah Campbell, Ord. Res., Manufacturing Service, Boston District Ordnance Office,
Lieut. Col. George S. Brady, Ord. Res., Manufacturing Service, Executive Section, Washington, D. C.,
Lieut. Col. Thomas F. Brown, Ord. Res., Manufacturing Service, Cincinnati District Ordnance Office,
Lieut. Col. Theodore Swann, Ord. Res., Manufacturing Service, Birmingham District Ordnance Office,
Lieut. Col. Thomas E. Durban, Ord. Res., Manufacturing Service, Pittsburgh District Ordnance Office,
Maj. John T. Wurster, Ord. Res., Manufacturing Service, Chicago District Ordnance Office,
Maj. Oscar H. Wurster, Ord. Res., Manufacturing Service, Chicago District Ordnance Office.

At St. Louis District Ordnance Office:

Maj. Lindsley M. Brown, Ord. Res., Manufacturing Service, St. Louis District Ordnance Office,
Capt. Archibald D. Methven, Ord. Res., Manufacturing Service, St. Louis District Ordnance Office,
Capt. Raymond B. Silverman, Ord. Res., Manufacturing Service, St. Louis District Ordnance Office.

At Philadelphia District Ordnance Office:

Capt. Richard W. Bond, Ord. Res., Manufacturing Service, Philadelphia District Ordnance Office.

At Baltimore District Ordnance Office:

Capt. Paul Anderson, Ord. Res., Manufacturing Service, Baltimore District Ordnance Office,
2nd Lieut. Gerald L. Parker, Ord. Res., Manufacturing Service, Baltimore District Ordnance Office.

At Fort Bragg, N. C.:

Capt. Edmund S. Van Brunt, Ord. Res., Manufacturing Service, Artillery Division, Washington, D. C.

At Erie Ord. Res., Depot:

1st Lieut. Price W. Williams, Ord. Res., Field Service, Erie Ord. Res. Depot.

At Birmingham District Ordnance Office:

2nd Lieut. William B. Johns, Jr., Ord. Res., Manufacturing Service, Birmingham District Ordnance Office.

At Benicia Arsenal:

Maj. Welton J. Crook, Spec. Res., Manufacturing Service, San Francisco District Ordnance Office,
Maj. Leon C. Van Bever, Ord. Res., Manufacturing Service, Artillery Division, Washington, D. C.,
Capt. James W. Fraser, Ord. Res., Field Service, Benicia Arsenal,
1st Lieut. Oliver M. Olson, Ord. Res., Manufacturing Service, Aircraft Armament Division, Washington, D. C.,
2nd Lieut. Richard C. Dehmel, Ord. Res., Manufacturing Service, San Francisco District Ordnance Office,
2nd Lieut. Charles B. McDonald, Ord. Res., Field Service, Benicia Arsenal,
2nd Lieut. Carl J. Penther, Ord. Res., Manufacturing Service, San Francisco District Ordnance Office.

At Watervliet Arsenal:

Maj. Charles K. Blatchly, Ord. Res., Manufacturing Service, Buffalo District Ordnance Office,
Maj. Milo M. Case, Ord. Res., Manufacturing Service, Chicago District Ordnance Office,
Capt. Ephraim J. Almquist, Ord. Res., Manufacturing Service, Artillery Division, Washington, D. C.,
Capt. Charles H. McKnight, Ord. Res., Manufacturing Service, Buffalo District Ordnance Office,
1st Lieut. Walcott D. Bartlett, Ord. Res., Manufacturing Service, Buffalo District Ordnance Office,
1st Lieut. Walter H. Montgomery, Ord. Res., Manufacturing Service, Artillery Division, Washington, D. C.,
1st Lieut. Harry H. Needham, Ord. Res., Field Service, Erie Ord. Res. Depot,
2nd Lieut. Donald D. Alexander, Ord. Res., Manufacturing Service, Buffalo District Ordnance Office,
2nd Lieut Frederick J. Mollerus, Ord. Res., Manufacturing Service, Buffalo District Ordnance Office,
2nd Lieut. Delbert A. Reesor, Ord. Res., Manufacturing Service, Buffalo District Ordnance Office.

Recently Commissioned Ordnance Reserve Officers

THE following reserve officers have recently accepted commissions in the Ordnance Department Reserve:

Capt. Harry W. Eckhardt, Ord. Res., 1105 Peters Ave., New Orleans, La.
Capt. Cyril E. Edmonds, Ord. Res., 310 Bert Ave., Trenton, N. J.
Capt. Donald M. Gregory, Ord. Res., 940 Green St., San Francisco, Calif.
Capt. Lloyd B. Patrick, Ord. Res., 16 So. Catherine St., Mobile, Ala.
Capt. Ferne M. Schmalle, Ord. Res., 1307 W. 32nd St., Cheyenne, Wyo.
1st Lieut. Justin J. Hanaw, Ord. Res., 2142 16th Ave., So., Birmingham, Ala.
1st Lieut. Robert J. King, Ord. Res., Eleanor Place, R. F. D. No. 2, New Britain, Conn.
2nd Lieut. John G. Bikle, Ord. Res., 715 N. Blount St., Raleigh, N. C.
2nd Lieut. Frank G. Brooks, Ord. Res., Oklahoma City Univ., Oklahoma City, Okla.
2nd Lieut. William C. Cauthen, Ord. Res., 2529 College Ave., Berkeley, Calif.
2nd Lieut. Arthur B. Colwell, Ord. Res., 72 Grove St., Pittsfield, Mass.
2nd Lieut. John L. Cope, Ord. Res., 106 Bay St., E., Savannah, Ga.
2nd Lieut. Richard C. Dehmel, Ord. Res., 2225 Blake St., Berkeley, Calif.
2nd Lieut. Volney J. Eaton, Ord. Res., 1920 Calvert St., Washington, D. C.
2nd Lieut. Carl W. Horack, Ord. Res., 2529 Chilton Way, Berkeley, Calif.
2nd Lieut. Rowland O. Huddleston, Ord. Res., Main St., Linwood, Northbridge, Mass.

2nd Lieut. George B. Jarrett, Ord. Res., 210 Westmont Ave., Haddonfield, N. J.
2nd Lieut. Thomas H. Johnson, Ord. Res., 268 Howland Ave., Englewood, N. J.
2nd Lieut. Edward C. Meinholtz, Ord. Res., 4812 Greer Ave., St. Louis, Mo.
2nd Lieut. John R. Moyniham, Ord. Res., 32 Admiral Rd., Buffalo, N. Y.
2nd Lieut. Winton I. Patnode, Ord. Res., 123 Kheel St., Rochester, N. Y.
2nd Lieut. Elmo L. Patton, Ord. Res., Ben Hill, Ga.
2nd Lieut. Marion B. Penn, Ord. Res., 1114 Tuscaloosa Ave., Birmingham, Ala.
2nd Lieut. Carl J. Penther, Ord. Res., 1070 Aileen St., Oakland, Calif.
2nd Lieut. Albert G. Redpath, Ord. Res., 4 West 43rd St., New York, N. Y.
2nd Lieut. Robert H. Reid, Ord. Res., 33 E. Elm St., Chicago, Ill.
2nd Lieut. William E. Ryon, Jr., Ord. Res., 1212 Bridge St., New Cumberland, Pa.
2nd Lieut. Ward B. Smith, Ord. Res., 2692 Moss Ave., Los Angeles, Calif.
2nd Lieut. Harry C. Snell, Ord. Res., Raritan Arsenal, Metuchen, N. J.
2nd Lieut. Albert G. Weppler, Ord. Res., c/o R. Herschel Mfg. Co., Peoria, Ill.
2nd Lieut. William A. Willets, Ord. Res., 439 W. 11th St., Erie, Pa.
2nd Lieut. Christopher H. Wollenberg, Ord. Res., Maiden Lane, Farmington, Conn.

Recently Assigned Ordnance Reserve Officers

THE following reserve officers have been assigned as indicated after their names since the last issue ARMY ORDNANCE:

Maj. Charles E. Smart, Ord. Res., Manufacturing Service, Buffalo District Ordnance Office, Watervliet Arsenal, Watervliet, N. Y.
Maj. Alfred M. Cressler, Ord. Res., Manufacturing Service, Cincinnati District Ordnance Office, Cincinnati, Ohio.
Capt. Harry W. Eckhardt, Ord. Res., Territorial Assignment Group.
Capt. Cyril E. Edmonds, Ord. Res., Territorial Assignment Group.
Capt. Donald M. Gregory, Ord. Res., Manufacturing Service, San Francisco District Ordnance Office, San Francisco, Calif.
Capt. Lloyd B. Patrick, Ord. Res., Territorial Assignment Group.
Capt. Ferne M. Schmalle, Ord. Res., Territorial Assignment Group.
1st Lieut. Justin J. Hanaw, Ord. Res., Manufacturing Service, Birmingham District Ordnance Office, Birmingham, Ala.
1st Lieut. Robert J. King, Ord. Res., Manufacturing Service, Bridgeport District Ordnance Office, Springfield Armory, Springfield, Mass.
2nd Lieut. John G. Bikle, Ord. Res., Territorial Assignment Group.
2nd Lieut. Frank G. Brooks, Ord. Res., Manufacturing Service, Ammunition Division (Inspector), Washington, D. C.
2nd Lieut. William C. Cauthen, Ord. Res., Territorial Assignment Group.
2nd Lieut. Arthur B. Colwell, Ord. Res., Manufacturing Service, Bridgeport District Ordnance Office, Springfield Armory, Springfield, Mass.
2nd Lieut. John L. Cope, Ord. Res., Territorial Assignment Group.
2nd Lieut. Clarence C. Dean, Ord. Res., Manufacturing Service, Bridgeport District Ordnance Office, Springfield Armory, Springfield, Mass.
2nd Lieut. Richard C. Dehmel, Ord. Res., Manufacturing Service, San Francisco District Ordnance Office, San Francisco, Calif.
2nd Lieut. Edward Gluck, Ord. Res., Manufacturing Service, New York District Ordnance Office, New York, N. Y.
2nd Lieut. Carl W. Horack, Ord. Res., Manufacturing Service, San Francisco District Ordnance Office, San Francisco, Calif.
2nd Lieut. Rowland O. Huddleston, Ord. Res., Territorial Assignment Group.
2nd Lieut. George B. Jarrett, Ord. Res., Territorial Assignment Group.
2nd Lieut. Thomas H. Johnson, Ord. Res., Manufacturing Service, New York District Ordnance Office, New York, N. Y.
2nd Lieut. John R. Moyniham, Ord. Res., Territorial Assignment Group.
2nd Lieut. Bertram V. Nutt, Ord. Res., Manufacturing Service, Rock Island Arsenal, Rock Island, Ill.
2nd Lieut. Winton I. Patnode, Ord. Res., Territorial Assignment Group.
2nd Lieut. Elmo L. Patton, Ord. Res., Territorial Assignment Group.
2nd Lieut. Marion B. Penn, Ord. Res., Territorial Assignment Group.
2nd Lieut. Carl J. Penther, Ord. Res., Manufacturing Service, San Francisco District Ordnance Office, San Francisco, Calif.
2nd Lieut. Albert G. Redpath, Ord. Res., Manufacturing Service, New York District Ordnance Office, New York, N. Y.
2nd Lieut. Robert H. Reid, Ord. Res., Territorial Assignment Group.
2nd Lieut. William E. Ryon, Jr., Ord. Res., Manufacturing Service, Philadelphia District Ordnance Office, Philadelphia, Pa.
2nd Lieut. Harold D. Shierman, Ord. Res., Manufacturing Service, Bridgeport District Ordnance Office, Springfield Armory, Springfield, Mass.
2nd Lieut. Ward B. Smith, Ord. Res., Territorial Assignment Group.
2nd Lieut. Harry C. Snell, Ord. Res., Field Service, Benicia Arsenal, Benicia, Calif.
2nd Lieut. Albert G. Weppler, Ord. Res., Territorial Assignment Group.
2nd Lieut. William A. Willets, Ord. Res., Territorial Assignment Group.

Historical

Early History of Ordnance Department, U. S. A.

MAJ. CHAS. O. GUNTHER, Ord. Res.

THE Act of the Continental Congress of 1785 ascertained and defined the powers and duties of the Secretary of War. By this Act the Secretary of War, among other duties, was required to receive into his care from the officers in whose possession they might be, all military stores, equipment, and supplies in the magazines of the United States or in other places, for the use of the military forces of the United States, and to keep up competent magazines for the purpose.

In September, 1789, the "Department of War" was established and the Secretary of War* was required, among other things, to perform and execute such duties as should from time to time be enjoined on or intrusted to him by the President of the United States relative to the "warlike stores" of the United States.

Five years later, in 1794, Congress provided for the erection and repair of arsenals and magazines and the establishment of national armories, placing these latter (as regards the number of workmen to be employed) under the direction of the Secretary of War. By this same Act Congress directed the employment of an officer to superintend "under the direction of the Department of War," the receiving, safekeeping, and distribution of the military stores of the United States, and to call to account all persons to whom the same might be intrusted.

In 1795 a Purveyor of Public Supplies was authorized whose duty it was, under the direction of the Treasury Department, to conduct the procuring and providing (among other things) of all arms and military and naval stores requisite for the service of the United States. In 1798 this officer was placed under the orders of the Secretary of War in respect to the procuring and providing of all kinds of military stores and supplies. In the same year the President of the United States was authorized, in case he should deem it expedient to meet a pending emergency, to lease for a term of years one or more suitable places where cannon could be cast and arms manufactured and authorized the employment of suitable workmen and the appointment of one or more persons to superintend such works "under the direction of the Department of War."

The original establishment of the Ordnance Department as a separate corps was by Act of May 14, 1812, a short time before the declaration of the War in 1812. Its organization and the duties it was to perform were accurately defined. It was then made to consist of one colonel, one major, four captains, eight lieutenants, and as many carriage-makers, blacksmiths, artificers, and laborers as the public service might require. By the Act of March 3, 1813, eight lieutenants were added and the Secretary of War was empowered to prepare general regulations for the government of the Ordnance Department "for the better organization of the General Staff of the Army of the United States." Five captains were added by Act of August 2, 1813.

At the close of the War of 1812-1814 a reorganization of the Ordnance Department was directed by the Act of February 8, 1815, when its status and duties were again defined. This act is considered the *organic law*.

In order to reduce and fix the military peace establishment, the Ordnance Department was merged with the Artillery by the Act of March 3, 1821, and it was not until April 5, 1832, that a bill was approved which granted once more a separate existence for the Ordnance Department.

The Ordnance Department was augmented in its *personnel* in 1838 and again in 1847. In 1861 a further increase was made and the Chief was advanced to the grade of brigadier general. A regrading of the officers was made by Congress by the Act of July 28, 1866, and in 1869 further promotions and appointments were stopped until a reduction of the Department by casualties should occur.

On February 21, 1872, the Committee on Military Affairs inquired into "the expediency of reducing by consolidation the number of staff corps and departments in the Army and making certain other changes in the laws relating to staff organizations." As a result of this investigation, the Ordnance Department continued in its separate existence as it does today, and its strength was again fixed by Act of June 23, 1874, and later acts.

The Chief of Ordnance was advanced to the grade of major general on October 6, 1917, under the Emergency Act and the grade of major general was authorized by the National Defence Act as amended July 1, 1920.

The following report was attached to a letter dated January 8, 1827, from George Bomford, Brevet Colonel to the Hon. J. Barbour, the then Secretary of War. It is of particular interest at this time, having been written just a century ago.

ARSENALS

Total amount per report of Dec. 1822,	$1,276,772	
Add for sites not included in the above	20,145	
Added in the years 1823, 1825, 1826..	205,700	
		$1,502,617

ARMORIES

Springfield, per Armory Book, 1825....	$ 332,608	
Harper's Ferry	584,859	
		917,467

*Henry Knox of Massachusetts was the first Secretary of War.

Cannon, Shot, Shells and Carriages		
63 tons brass guns @ $1,200 per ton	$ 75,600	
1,828 tons iron guns @ $150 per ton	274,200	
1,007 tons cannon balls @ $100 per ton	100,700	
702 tons shells @ $150 per ton	105,300	
570 gun carriages @ $150 each	85,500	
		$ 641,300
Small Arms		
398,778 muskets @ $12 each	$4,785,336	
22,664 rifles @ $15 each	339,960	
34,859 pistols @ $8 each	278,872	
32,824 swords @ $5 each	164,120	
		5,568,288
Ammunition		
10,504 bbls. of powder @ $20 per bbl.	$ 210,080	
621,946 lbs. of nitre @ 9c per lb.	55,975	
397,440 lbs. surphur @ 3c per lb.	11,923	
6,549,000 musket cartridges @ 2c each	130,980	
8,834,000 flints	26,500	
107,450 cannon cartridges	20,490	
Slow match	4,457	
380 tons lead @ $120 per ton	45,600	
62,183 rounds strap case and grape shot @ 70c	43,528	
13 tons loose grape and canister shot	29,500	
		579,033

Add for unwrought materials, wood, iron, etc., and for tools and machinery on hand at the several Arsenals	$ 291,295
Total amount	$9,500,000

By the year 1819 the following arsenals besides the two armories established in 1794 had been either purchased, built or were under construction:

Allegheny—Pittsburg, Pa.	1814
Rome—Rome, N. Y.	1813
Watervliet—West Troy, N. Y.	1814
Augusta—Augusta, Ga.	1817
Bellona—Richmond, Va.	1816
Frankford—Philadelphia, Pa.	1816
Pikesville—Pikesville, Md.	1816
Washington—Washington, D. C.	1816
Watertown—Watertown, Mass.	1816
Baton Rouge—Baton Rouge, La.	1819

The number of arsenals had increased to 24 in 1860. The value of Arsenals and armories in the United States in 1858 just previous to the War, together with all the military material they contained, was estimated at $21,670,022.19. The annual inventory for June 30, 1871, showed a money value of property in possession of the Ordnance Department of $53,832,111.02.

Cadets Make Annual Visit to Aberdeen Proving Ground and Frankford Arsenal

CADETS of the First (senior) Class of the Military Academy made their annual ordnance trip to Frankford Arsenal and Aberdeen Proving Ground beginning Sunday, April 24th. Two hundred and eight cadets, accompanied by Lieut. Col. Campbell B. Hodges, Commandant of Cadets, and Maj. Earl McFarland, Ord. Dept., U. S. A., Professor of Ordnance and Gunnery, made the trip. The entire party left West Point at 1:30 P. M., Sunday, April 24th, arriving at Frankford Arsenal 6:00 P. M. the same day. Monday and Monday night were spent at the Philadelphia Arsenal. On Tuesday and Wednesday morning the cadets visited the Aberdeen Proving Ground, Maryland. The class returned to West Point Wednesday afternoon, April 27th.

This trip is conducted by the Department of Ordnance and Gunnery of the Military Academy and constitutes a part of the course of instruction given to the members of the senior class, who graduate and become officers of the Army in June. The practice of taking the senior cadets to arsenals is of long standing, and the War Department feels that such a trip, by broadening the student's horizon and general knowledge of military equipment, better fits him to assume the duties and responsibilities of the new position he is soon to occupy.

At Frankford Arsenal the class inspected a modern manufacturing plant and observed the arrangement and the engineering features involved in such an establishment. Special attention was given to plant organizations and systems used in keeping records of work and in determining costs of articles in production. Specifically, a study was made of the methods of manufacture of small arms ammunition and field artillery fuzes.

At Aberdeen Proving Ground, the 35,000-acre reservation which is the testing ground for all of the ordnance used by the Army, the cadets witnessed firings from field guns of all sizes up to 9.2 inches, and from guns on self-propelled mounts, from antiaircraft guns on fixed and automotive mounts, and from seacoast and railway artillery. Tests and maneuvers of tanks and tractors, both service types and experimental, were witnessed and an examination made of various small arms and semiautomatic weapons. An inspection was made of American and foreign ordnance matériel and of the ballistic instruments and special guns used in proving ground work. A detailed explanation by proof officers was made in connection with each demonstration so that the cadets came away with a very definite idea of what they had seen.

An antiaircraft exhibition was staged for the cadets while at Aberdeen. The new 37-mm. Browning automatic machine gun, completed just before Mr. Browning's death, demonstrated its worth. This gun may possibly revolutionize the shelling of low-flying aircraft in time of war. Its projectile can be fired at an airplane at a distance of 5,000 yards and it is equipped with a fuze so sensitive that the shell detonates on contact even with the plane fabric and acts like shrapnel. This means that, in the future, one of these bullets will not have to register a direct hit on the aviator or some vital part of his plane, in order to cripple it.

During their senior year at West Point, cadets study the abstract and technical theories of ordnance, together with descriptions of service ordnance matériel. This annual visit to Aberdeen and Frankford shows them how the theories are applied and how results are obtained.

Patents

Brief Descriptions of Inventions of Interest to Ordnance Engineers

Compiled by W. N. Roach, Chief, Patent Section, Office of the Chief of Ordnance

Ammunition and Explosives

THE following are some of the recent patents relating to ammunition and explosives.

Bohdan Pantoflicek has been granted patent No. 1,618-944, for a centrifugal fuze. The device covered by this patent is a special form of striker, normally held safe by a centrifugally actuated rotor which is mounted on a shaft at right angles to the axis of rotation of the shell and which is urged in one direction by a spring and normally locked against motion in such direction, the lock being released by movement of the rotor against the spring under centrifugal force, the spring then acting when rotation of the shell ceases to move the rotor to position to release the firing pin.

Col. Odus C. Horney, Ordnance Department, U. S. A., formerly Commanding Officer at Frankford Arsenal, has been granted patent No. 1,619,867, for a primer for cartridges. This patent covers a primer cup made of an alloy which, while having necessary yielding qualities so as to respond to the blow of the firing pin, yet is of sufficient strength to withstand the pressures produced on ignition of the primer. This primer cup possesses a high degree of resistance to chemical action.

Patent No. 1,624,401, has been granted to Bernhard J. Flurscheim for a brisant explosive. This invention covers an explosive composed of tetranitroaniline mixed with a fusible nitro compound or fusible nitro compounds which compound or compounds water proof the tetranitroaniline.

Patent No. 1,624,600, for a colored-vapor signal, has been granted Thomas G. Hitt. The main object of the invention is to provide a colored cloud, the color of which will be visible with transmitted as well as reflected light.

Edmund von Herz has been granted patent No. 1,625,-966, for a method of manufacturing detonating compositions for explosives and percussion caps. The patent covers the substitution of metallic salts of the iso-nitroamines for fulminate of mercury and lead azide for percussion caps.

Patent No. 1,626,363 for a gravity bomb, has been granted to Elmer A. Sperry. The main object of the device covered by this patent is the provision of stabilizing means for the bomb.

Patent No. 1,627,638, for a process for making smokeless powder has been granted to Francis I. DuPont and Ernest DuPont, assignors to U. S. F. Powder Company. This invention relates to a method of treating nitrocellulose powder which has a flame propagating agent incorporated therewith and consists in using as a blending liquid one that is subsequently useful in colloiding.

The same patentees, Francis I. DuPont and Ernest DuPont, assignors to U. S. F. Powder Company, have been granted patent No. 1,627,639 for flashless cannon powder. This invention covers a nitrocellulose powder, which may contain nitroglycerin, containing distributed grains of a mixture composed of charcoal and a nitrate.

John M. Olin and Arthur S. O'Neil, assignors to Western Cartridge Company, have been granted patent No. 1,627,859, for a propellant powder. The main object of this invention is the production of a propellant powder composed of a mixture of slow burning and quick burning powders of practically the same densities whereby sifting and segregation of the powders is prevented. This is accomplished by mixing nitrocellulose powder grains and grains of black powder of the same densities.

Patent No. 1,627,861 for a propellant powder and process for making the same, has been granted to Arthur S. O'Neil, assignor to Western Cartridge Company. The main object of this invention is to produce a powder grain having a dense nitro-cellulose colloid as a base surrounded by a porous envelope, thereby producing an acceleration of the burning of the powder so as to enable the same to be used in cylinder guns and small arms. This result is accomplished by treating a nitrocellulose powder grain with a solvent for a sufficient time to secure the desired penetration of the surface of the grain and then chilling the grain with cold water to set the surface in its swollen and porous condition.

Arthur S. O'Neil, assignor to the Western Cartridge Company, has been granted patent No. 1,627,862, for a propellant powder and process of making the same. The object of this invention is to produce a powder grain having a dense core surrounded by a porous envelope impregnated with an oxidizer, and, further, to produce a flaky grain.

Mr. O'Neil, assignor to Western Cartridge Company, also has been granted patent No. 1,627,863, for an explosive powder and process of making same. The object of this invention is the production of globular or spherical explosive grains. The process consists in melting the explosive, as for instance, ammonium nitrate, pouring the melted explosive into a seive or pan having perforations of a predetermined size and permitting the droplets falling from the pan to pass through sufficient air space

to solidify, after which they may be received in a receptacle or tank containing a water-proofing compound, if it is desired to water proof the grains.

Patent No. 1,627,691 for a smokeless explosive powder and process for making the same, has been granted to Francis I. DuPont and Ernest DuPont, assignors to U. S. F. Powder Company. The object of this invention is to so lower the carbon content of the powder as to reduce flash. This is done by mixing nitrocellulose and nitrate of ammonium to which may be added nitroglycerin.

Francis I. DuPont and Ernest DuPont, assignors to U. S. F. Powder Company, also have been granted patent No. 1,627,692, for a smokeless explosive powder and process for making the same. The invention consists in mixing barium nitrate and potassium nitrate with soluble nitrocellulose and then colloiding. It is preferable to use about two parts of barium salt and one part of potassium salt and have this mixture form from 8 to 12 per cent of the entire explosive.

The same patentees, assignors to U. S. F. Powder Company, have been granted patent No. 1,627,693, for a smokeless explosive powder and process for making the same. The object of this invention is the producing of nitrocellulose powder containing a flame propagating agent which will increase the rate of burning without increasing the chamber pressure. This is accomplished by incorporating soluble nitrocellulose and a relatively small portion of black powder and then colloiding the nitrocellulose with ether and alcohol.

Patent No. 1,627,694 for a smokeless explosive powder has been granted to Francis I. DuPont and Ernest DuPont, assignors to U. S. F. Powder Company. The main object of this invention is to provide a specific flame propagating agent, consisting of potassium bichromate and charcoal, the same to be incorporated with a nitrocellulose by the methods outlined in the former cited patents.

Artillery

The following patents relate to artillery:

Ralph L. Goetzenberger, formerly an ordnance engineer at Frankford Arsenal, has been granted patent No. 1,616-183, for a fire control mechanism. The device covered by this patent is intended primarily for use with antiaircraft guns and provides means for automatically setting the fuze and correcting for dead time.

Patent No. 1,616,660 has been granted James B. Henderson, for a sighting telescope. This telescope is intended for use on a moving platform such as a ship or airplane and there is provided in the stabilized field of view of the sighting telescope an indication of the motion of the platform relative to the line of sight.

Harry C. Zimmerman, of the Office of the Chief of Ordnance, has been granted patent No. 1,619,173, for a cradle lock for gun carriages.

Thomas A. Conlon, of the Office of the Chief of Ordnance, has been granted patent No. 1,619,193, for a loader for guns. The loader covered by this patent is intended for use with guns which must be placed in high elevation as in antiaircraft fire.

Harry C. Zimmerman, of the Office of the Chief of Ordnance, has been granted patent No. 1,619,843, for a training mechanism for gun carriages.

Mr. Zimmerman also has been granted patent No. 1,620-850, for the formation of passages between chambers in a gun cradle block.

Patent No. 1,620,851 for a traversing gear for guns, has been granted Mr. Zimmerman. The main object of the invention is the provision of means for increasing the range of traversing without moving the wheels of the gun carriage or resetting the spade.

Patent No. 1,620,852, has been granted Mr. Zimmerman, for a crank axle for gun carriages.

Edwardo Bustemante has been granted patent No. 1,620,994, for a device for firing cannon. This invention contemplates the provision of means for supplying a mixture of oxygen and hydrogen to the explosive chamber of a gun and igniting the same by means of a spark.

Patent No. 1,621,201 for a fire control apparatus, has been granted to James B. Henderson. The device covered by this patent is a stabilized sighting device intended for use in moving platforms such as ships or aircraft.

Arthur T. Dawson and Geo. T. Buckham, assignors to Vickers, Ltd., have been granted patent No. 1,622,861, for an ordnance breech mechanism. The main object of this invention is the provision of a breech mechanism for a semiautomatic gun convertible at will into a quick firing gun.

Raymond W. Anderson has been granted patent No. 1,624,523 for an apparatus for directing the sighting of guns. The apparatus is intended primarily for use in antiaircraft fire control and provides means for computing and presenting automatically and continuously the elevation, fuze setting and azimuth readings, the computations being based on lineal velocities.

Eugene Schneider, assignor to Schneider et Cie, has been granted patent No. 1,626,560, for a transmitting apparatus utilizing the principles of the Wheatstone Bridge.

Small Arms

The following recent patents relate to small arms:

Frank A. Fahrenwald has been granted reissue patent No. 16,556, for a fire arm and alloy for making same. This patent purports to cover a firearm made from a non-corrodable iron alloy.

Patent No. 1,617,683, for an automatic gun, has been granted to Calvin E. Grill. The main object of this invention is the provision of mechanism which will automatically extract a cartridge from the gun barrel, cock the firing pin and insert a loaded cartridge into the gun barrel in one complete cycle of operation.

John H. Redfield has been granted patent No. 1,618,225 for a gun sight. The main object of the invention is the provision of a shielded or hooded sight of simple construction.

John M. Browning has been granted patent No. 1,618,-510 for an automatic firearm. The invention relates to an automatic pistol and aims to provide a simple, economic, reliable and safe device of that character.

Chas. E. Blizard, assignor to Winchester Repeating Army Company, has been granted patent No. 1,618,740, for a sight for firearms. The main object of the invention is the provision of a sight with fine adjustments for zeroing.

Books

Wilhelm Hohenzollern: The Last of the Kaisers. By Emil Ludwig. Translated from the German by Ethel Colburn Wayne. New York: G. P. Putnam's Sons. 1927. 520 pp., illustrated, $5.00.

THE reading public is indeed indebted to the author for presenting this complete and interesting biography of the German ex-Kaiser and to the translator for making it so acceptably available to readers of English. Perhaps an inadequate mellowing by time has had insufficient influence to permit of a proper unbiased conception of this man's character. However, Ludwig offers a most conscientious and clever analysis of the influences of family, environment, and advisors which were character builders for good or bad and shows the effects thereof on the history of the world and of the German Empire. The author shows decisively that everything in the Kaiser's life tended to make him unapproachable, militaristic, autocratic, and egotistical, and to reflect these attributes in the political strategy and intrigues of the nation.

Delightful side lights are thrown on those personalties in the Crown Council, Army and Navy, who surrounded the Emperor and much is told of their diplomatic intercourse and court intrigue which culimated so disastrously in the World War. The collosal failure of German diplomacy and the consequent embarrassment and danger occasioned thereby is critically expounded. Those who have lived through the last twenty or more years should not fail to read and profit from Emil Ludwig's masterful treatment of this feature of contemporary history. It is unqualifiedly recommended to all.

The Rhineland Occupation. By Henry T. Allen, Maj. Gen. U. S. Army. Indianapolis: The Bobbs-Merrill Co. 1927. $5.00.

THE author recounts the problems which arose and the solutions arrived at for the administration of the occupied German territory by the Interallied Rhineland High Commission during American participation. As an unofficial American observer and as dual representative of the State and War Departments in a situation made doubly delicate because of our failure to make peace with Germany he had ample opportunity to exercise his great ability in statesmanship and as an administrator.

He shows how the French continually jeopardized the American desire for a just and lasting peace, and how over zealousness on their part probably prohibited the establishment of a separate Rhineland state. Constantly did our representatives oppose the Separatist Movement, excessive restrictions, the extension of the occupied area, and the removal of German officials.

We are indeed indebted to General Allen for an authoritative and dispassionate account of this historic event and agree with him that the question of the military administration of occupied territories should be made a study by our higher officers.

The British Navy in Adversity. A Study of the War of American Independence. By Captain W. M. James, C. B., R. N. New York: Longmans, Green & Co., Ltd. 1926. $8.50.

CAPTAIN JAMES gives a very interesting and clever account concerning the British naval aspects of the War of American Independence, with sufficient political and naval history to show how England suffered from an incompetent, corrupt and vacillating government and how the accomplishments of those eminent commanders, Howe, Rodney and Hood were under such conditions the more remarkable.

During the War much was learned of naval tactics, ordnance matériel, preparedness, and of political and naval strategy; all of which is brought out by a thorough and masterly analysis. Extracts from official reports and personal correspondence show the author's sources of information, throw illuminating side lights on commanders and conditions of personnel and matériel and make this account all the more delightful.

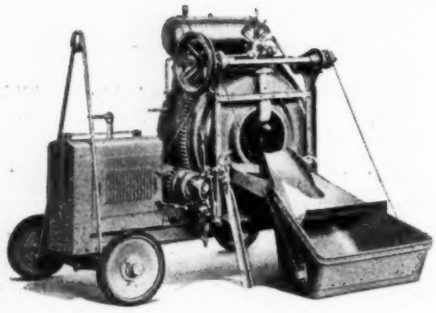
Altogether a pleasing, and unbiased and masterly history, and one which furnishes much food for thought for those who are too prone to attribute the success of all American war ventures to an exhaulted American prowess without discounting the contributory influences independent of American control.

George Washington: The Human Being and the Hero, 1732-1762. By Rupert Hughes. New York: William Morrow & Co. 1926. $5.00.

RUPERT HUGHES in the present day advanced spirit and knowledge of historical exposition, in which unaltered facts and the whole truth prevail, has assembled all that indicates the thought, action, and character of this great leader and conscientiously without

HOTEL ASTOR
ARMY *and* NAVY HEADQUARTERS
The Most Centrally Located Hotel in New York
FRED'K A. MUSCHENHEIM

KOEHRING 5-S
DANDIE
Mixer



A light concrete mixer of sturdy construction for sidewalks, foundations, floors, walls and other jobs where a one bag mixer is the desired size. Quickly and easily portable.

Rubber tires or steel rimmed wheels. Power charging skip or low charging hopper and platform. Single cylinder gasoline engine and worm drive transmission.

KOEHRING COMPANY

Manufacturers of Pavers, Mixers—Gasoline Shovels, Cranes, Draglines

Milwaukee, Wisconsin

HERCULES
SPORTING POWDERS

HERCULES POWDER COMPANY
(INCORPORATED)
Wilmington, Delaware

favor to friend or foe has thoroughly analyzed these facts so that the true character of Washington stands out clearly, and withal shows him to be more a hero and more a man. He cites his sources, analyzes what is there for all to read, and cleverly builds up from Washington's own words his true character and further shows what may be clearly read between the lines.

This is an intensely interesting and highly valuable authoritative addition to historical literature which should profit its every reader and one which promises that the volumes to follow covering the Revolution and the Presidency will be bristling with tense situations and startling disclosures.

Italy Under Mussolini. By William Bolitho. New York: The Macmillan Co. 1926. $2.00.

THE subject matter of this book was published by *The World* in 1925 as a series of articles, which are here collected. The author shows the origin of the Fascist Movement, its background, growth, policies and the motives of its leaders. Of Mussolini he says that he, "is neither a Napoleon nor a Mohammed, but a variety of Socialist boss who will run to other editions," and that "He has robbed his own country of liberty and all that makes life in common worth while." This he has done by press censorship, veto on associations, the organization of street violence and other tyranny. The economic depression of Italy under Mussolini is clearly shown.

Napoleon's Campaign of 1812. By Hilaire Belloc. New York: Harper & Brothers. 1926.

UNTIL the World War put into motion millions of men in a single theater of operations, the military annals of mankind recorded no greater grouping of troop masses than assembled under Napoleon's banner for the Russian campaign in the troubled German provinces of the great conqueror. Shortly thereafter in the spring of 1812 the world saw with trepidation the launching of a half million men across the Nieman against the strength of Imperial Russia and there began the greatest and most unfortunate effort of the French Revolution and the turn in the tide of victory for the Man of Destiny.

Such a campaign naturally becomes an epic of intense interest and it is not surprising that every student of military history ponders carefully the lessons taught by the great disaster, and eventually has his faith in the genius of Napoleon somewhat shaken.

The narrative begins with the departure of Napoleon from Dresden. The burning of Moscow and the scenes of the retreat are graphically described and the end comes when Napoleon takes leave of the remnant of his army after the brilliant crossing of the Beresina. The feeling is left that the completeness of the account of the campaign has been impaired by the rather hasty dismissal in one brief paragraph of the remainder of the retreat after the Beresina had been crossed.

Airmen and Aircraft. By Henry H. Arnold. New York: Ronald Press Company. 1926. $5.00.

MAJOR ARNOLD has attempted to deal in non-technical terms with the characteristics of various types of aircraft, including their principles of operation, and follows this easily understood analysis with a review of the qualifications and training necessary for the men who pilot aircraft. A chapter is devoted to the famous World

War fliers whose exploits furnish the most interesting individual actions of that great conflict.

The progress of commercial aeronautics and the present status of the application of aircraft to commercial uses are dealt with in another chapter. The book closes with the author's conception of the aircraft of the not-distant future both as military weapons and as means of commercial transportation.

Panama and the Canal Today. By Forbes Lindsay and Nevin O. Winter. Boston: L. C. Page & Co. 1926.

A GREAT undertaking, ably conceived and executed and absolutely free from corruption and graft, the Panama Canal remains a monument to this generation and serves as an inspiration for the author's thorough treatment of the country and the canal passing through it.

Part I, written by Mr. Lindsay in 1912, deals with the canal and its history.

Part II, written by Mr. Winter, concerning the canal of today, deals with the history and resources of the Republic of Panama. In this section the romantic hitsory of the isthmus is first dealt with, much space being given to the sacking of Panama by the buccane r Morgan. The country of today is then described and the resources estimated in a businesslike manner.

The volume is profusely illustrated and contains several appendices, including the Hay-Varilla convention for the establishment of the canal and certain statisties concerning the canal. It can be unhesitatingly recommended as an authoritative and interesting work on our greatest national utility and the country through which it passes.

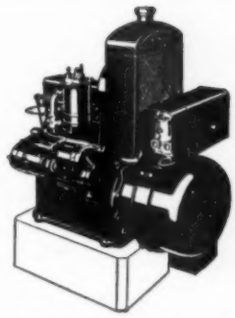
Free and Captive Balloons. By Ralph H. Upson and Lt. Col. Charles de Forest Chandler. New York: The Ronald Press Company. 1926. $5.00.

THIS book includes a wealth of technical information presented in condensed form, as well as many photographs, charts and diagrams. It is a reference volume of value to all balloon pilots or observers and to all those whose work has any connection with balloons or airships.

Colloid Chemistry: Theoretical and Applied. Vol. I, Theory and Methods. Edited by Jerome Alexander. New York: The Chemical Catalog Company. 1926. $14.50.

THIS is the first volume of a monumental work undertaken by Mr. Alexander in which he is making an effort to collect all available information on the subject of colloids. Realizing the magnitude of the undertaking, he took steps to secure the cooperation of everyone who might be capable of discussing any phase of the subject, and as a result has received contributions from representatives of many countries, many of whom are well known authorities. Volume I contains 60 of these contributions, including two by the editor, all relating to "Theory and Methods." Volume II will cover "Biology and Medicine," and Volume III "Technology."

The book is in no sense a comprehensive treatise on colloid chemistry, but is a remarkable compilation of all sorts of information on this very broad subject. Some of the papers fail to present any new data, while others contain information either not previously published or not available in English. In many instances the editor has expressed his own views or comments by means of foot notes. This work should be invaluable to those teaching or specializing in any field of colloid chemistry.



PORTABLE ELECTRICITY

Electric light and electric power whenever and wherever needed—that makes the compact, easily transportable Kohler Automatic Electric Plant desirable equipment for military organizations.

It can be used to generate electricity for searchlights at landing fields or at observation posts; to light headquarters; to operate machinery in repair shops. It is valuable in emergencies of all kinds.

The Kohler Automatic Electric Plant is *powerful, sturdy, dependable, portable.* It starts and stops automatically. Generates 110-volt current. Has no large storage batteries—starting battery only.

Write for complete information.

KOHLER OF KOHLER

Kohler Co., Founded 1873, Kohler, Wis., U. S. A.
Branches in Principal Cities

Western

World Champion Ammunition

for Rifle, Pistol *and* Shotgun

Super-X—The long range shotgun shell
Xpert—The all-'round shotgun shell
Field Shotgun Shells—The choice of champions
Lubaloy—Non-fouling bullets
Open Point Expanding Bullets
Boat Tail Bullets
Non-Corrosive Priming .22 Cartridges
Marksman—A highly accurate .22 long rifle cartridge
Some of the above are used by the United States and other governments.

Brass Mill Division

Highest quality Brass, Bronze, Phosphor Bronze, Nickel Silver; also special alloys for special purposes, supplied in rolls, sheets, strips, plates, circles.

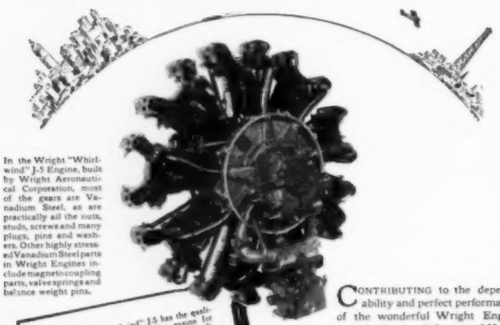
Stamped and drawn parts, fabricated from non-ferrous alloys and supplied to other manufacturers. Our skilled technical men will gladly help solve your problems.

WESTERN CARTRIDGE COMPANY

East Alton, Ill., U. S. A.

San Diego, California
To Paris, France
Without Engine Trouble

Is The Remarkable Performance of the Wright "Whirlwind" J-5 Engine With Vital Parts of Vanadium Steel



In the Wright "Whirlwind" J-5 Engine, built by Wright Aeronautical Corporation, most of the gears are Vanadium Steel, as are practically all the nuts, studs, screws and many plugs, pins and washers. Other highly stressed Vanadium Steel parts in Wright Engines include magneto coupling parts, valve springs and balance weight pins.

The Wright "Whirlwind" J-5 has the qualities most desired in an aviation engine for commercial service. It is a source of smooth, steady, reliable power. It has probably undergone more severe and more extensive endurance testing on the bench than any other aviation engine, and this has been followed by extensive testing in the air. One standard engine from the regular production run did 180 flying hours in cross-country work, racing and demonstration, and then went ahead and broke the world's duration record by a continuous flight of 51 hours. No better proof of trouble-free durability plus incomparable economy could be given.

Reprinted from "The Wright Engine Builder" —World's Record Number

CONTRIBUTING to the dependability and perfect performance of the wonderful Wright Engine were its many vital parts of Vanadium Steel, selected for its "extremely high and uniform tensile strength, hardness and resistance to fatigue."

Write for data on Vanadium Steels in applications in which you are interested.

VANADIUM CORPORATION OF AMERICA
New York Detroit

VANADIUM STEELS
for strength, toughness and durability

AMERICAN MANGANESE STEEL CO.
Chicago Heights, Illinois

Aircraft Power Plants. By Edw. T. Jones, Robt. Insley, Frank W. Caldwell and Robt. F. Kohr. New York: The Ronald Press Co. 1926. $4.25.

IT is said that money makes the world go round and oats make the mare go, but gasoline engines, without any figure of speech whatever, make aircraft go.

Airplanes could undoubtedly have been flown decades ago had power plants light enough been developed to carry them. Many years before the first successful flight of airplanes a great inventor declared: "If a power plant can be developed which will be below 10 pounds per horsepower in weight then an airplane can be made to fly." This was accomplished. Not only this, but the weight of power plants per horsepower has been gradually cut down until the standard airplane engine may now be said to weigh in the neighborhood of 1½ pounds per horsepower, or 2 pounds at most.

The authors of this volume go into the matter of power plants in a thorough manner. The history of power plants, however, is not discussed but the more modern engines are presented in all their advantages and short-comings.

Theory of Vibrating Systems and Sound. By Irving B. Crandall. New York: D. Van Nostrand Company. 1926.

THE need for up-to-date texts on acoustics is keenly felt in this day of rapid development of sound radiation devices. Mr. Crandall is eminently well able to handle the subject as a member of the technical staff in one of the country's leading laboratories of acoustic research and much of the subject matter in his book savors of the practice in that laboratory.

Those interested in sound radiation problems will find a very convenient reference in the brief theories on resonance phenomena, acoustic filters, conical and exponential horns, architectural acoustics and reverberation dealt with in the fourth and fifth chapters. The review of modern practical acoustic developments and the accompanying references found in the appendix will appeal to the research student. The objective of the author to develop an indispensable minimum of established theory and show how effectively it lends itself to practical applications, is admirably well done.

The Great Crusade, A Narrative of the World War. By Joseph T. Dickman, Maj. Gen. U. S. Army. New York: D. Appleton & Co. 1927. $2.50.

GENERAL DICKMAN herein clearly tells of the parts played by the various organizations he commanded during the World War, the difficulties encountered and the results achieved. Especially vivid is the account of the American operations around Chateau Thiery wherein great sacrifice was made to stop the German "Peace Offensive" of July, 1918.

Concerning the concluding actions he says, "The battle of November 1 and 2, 1918, is the greatest feat of arms ever performed by an American Army. The plan was purely American, and the tactical execution was the climax of the American fighting spirit. The battle is a classic and will forever be recognized as the final blow that drove the hosts of Germany to the very verge of collapse and ended the War."

It is about the same operation and the action of the 1st Division on November 6-7 in crossing the entire sector

of the 1st American Corps that General Liggett says was "the worst tactical atrocity that had ever come to his knowledge." Of the struggle for Belleau Wood, June, 1918, the author says, "It was magnificant fighting, but not modern war."

With General Dickman's vast army experience and this theme for inspiration one looks for more of a masterpiece than the present volume appears to be. Better maps would enhance its value greatly.

My Army Life. By Lieut. Gen. The Earl of Dundonald, K. C. B., K. C. V. O. New York: Longmans, Green & Co. 1926. $7.50.

LORD DUNDONALD here gives his experiences of forty years as a soldier, the ideas developed and conclusions drawn as a result of those experiences. In an entertaining and convincing manner he has presented his facts and conclusions.

Methods of using smoke and gas in warfare was a heritage of his from his father, Admiral Lord Dundonald. His secret plans were submitted on the outbreak of the World War to Lord Kitchener but it was only by dint of great perseverance in the face of much discouragement that defence measures based on his ideas were finally adopted.

His trying experiences with politicians when in charge of the Canadian Militia are vividly recounted. Maps would be of material aid to the reader in following the author up the Nile, across the Bayuda Desert, and across Natal into the Transvaal. The book is charmingly written and should be an inspiration to those following a military career.

The World Crisis, 1916-1918. By Winston S. Churchill. New York: Charles Scribner's Sons. 1927. 2 vols. 8 vo. $10.00.

IN general these volumes are an impeachment of the doctrines of modern military thought and a description of the munitions problems of England during the World War. As a personal narrative of the methods and problems of the Ministry of Munitions they are very acceptable. But wherein the author undertakes to judge the Allied and German commanders, their decisions and tactics, he criticises beyond his ability.

The Battle of Jutland is described admirably for the layman to read and makes it easy to follow Churchill's severe and thorough criticism of the tactics and strategy employed. Sir John Jellicoe is found fault with in the matter of scouting, navigating, signaling and in fleet deployment. Vital questions are raised concerning protection of ammunition hoists, handling rooms, and armor belts.

Effort is made to justify the Dardanelles fiasco which Churchill advocated and to show wherein it should have been pushed to a successful conclusion.

Churchill attributes the defeat of Germany to three cardinal mistakes: the march through Belgium regardless of the effect on Great Britain; the unrestricted U-boat warfare; and the use on the western front of troops drawn from the collapsed Russian front, and says that, "the moral consequences of the United States joining the Allies was indeed the deciding cause in the conflict."

These volumes are excellently written, are tremendously interesting, and are an authoritative account of the British munitions problems.

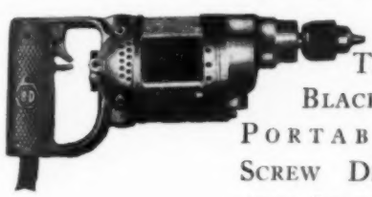
KB TRADE MARK

Core Binder and Facing Flour

Possesses merit to a marked degree and is now in general demand by foundries that are guided by quality considerations. Sample and information booklet on request.

KNEFLER-BATES Manufacturing Company
INDIANAPOLIS
U. S. A.

BLACK & DECKER
Portable Electric Tools
"With the Pistol Grip and Trigger Switch"



There is a BLACK & DECKER PORTABLE ELECTRIC SCREW DRIVER, ELECTRIC SOCKET WRENCH, ELECTRIC TAPPER, ELECTRIC GRINDER or BUFFER for every need.

These tools are rendering the highest type of service in every civilized country in the world.

The BLACK & DECKER MFG. CO.
TOWSON, MD.

COLT'S FIREARMS

Leadership! From the earliest Colt made in 1836 to the masterpiece of today Colt's supremacy has been unquestioned.

As Always "The Best That Money Can Buy"

Colt's Patent Fire Arms Mfg. Co.
Hartford, Conn., U. S. A.

Manufacturers of: Colt's Revolvers, Colt's Automatic Pistols, Colt's (Browning) Automatic Machine Guns, Colt's (Browning) Automatic Machine Rifles, Thompson Submachine Guns, Autosau Dish Washing Machines, Autosau Metal Parts Washing Machines.

The ORTHOPHONIC VICTROLA

is years ahead of all other reproducing instruments

THROUGH the exclusive Victor Orthophonic principle, the new Orthophonic Victrola reproduces tones that are full, round, mellow, *lifelike!* You hear your favorite selections *exactly* as if the living artist stood before you.

You must really *hear* the Orthophonic Victrola to appreciate its almost incredible performance. Get your nearest Victor dealer to play you the latest Victor Records on this amazing instrument. See him—*today!*

The New Orthophonic Victrola

VICTOR TALKING MACHINE CO. CAMDEN, NEW JERSEY, U. S. A.

Air Warfare. By Maj. W. C. Sherman. New York: Ronald Press Company, 1926. $4.25.

MAJOR SHERMAN opens his discussion with a general resumè of the principles of air warfare which epitomizes the human and material elements of such combat. Then follows a chapter dealing with the characteristics of various types of aircraft. Individual combat and the use of the armament and the maneuverability of the airplane in such combat are next treated. Separate chapters are then devoted to the service of observation for the Army, pursuit aviation, attack aviation, and bombardment. Anti-aircraft defense, the advantages and disadvantages of cannon in dealing with enemy aircraft, the taetical distribution and use of cannon and machine guns, the use of searchlights, and—a new thought—the importance of anti-aircraft units on the ground as an information service for the Air Corps are embodied in a well written chapter. Air logistics, including a thorough discussion of field supply and maintenance of air units, the problem of moving such units, and the theater of operations airdrome of the future, then follow, and the book is concluded with a discussion of naval aviation.

Shale Oil. By Ralph H. McKee. New York: The Chemical Catalog Company. 1925. $4.50.

DURING recent years, the consumption of petroleum has increased at such a rate as to cause considerable conjecture as to the future of the industry. Estimates of oil reserves are misleading, inasmuch as new fields are constantly being discovered and new wells are being opened up in fields thought to be failing. It is reasonable to assume, therefore, that the future of the industry is secure for a reasonably long time to come, but with constantly increasing consumption, there will come a time when petroleum will no longer gush from the ground in sufficient quantities to meet the demands. It is then that we must turn to the vast deposits of oil shale for our supply. Extraction of oil from the "stone" is not comparable with obtaining oil by drilling; it is costly, requires large-scale operations, and therefore will not be developed extensively until the demands can no longer be met by the wells.

This volume presents a clear picture of the shale oil situation and covers every phase of the subject in as much detail as possible in a single volume.

A Reporter for Lincoln. By Ida M. Tarbell. New York: The Macmillan Co. 1927. $1.60.

THIS is an account of the adventures of Henry E. Wing when he was a cub reporter for the New York *Tribune* during the last year of the Civil War and who through loyalty to his paper was sentenced by Secretary of War Stanton to be shot. Intervention by the President led to his rounding out a long and happy life and to a deep friendship between the two which was ended by the tragic death of Lincoln.

As a "Camp Walker," which may be known as a man who back home had always gone "up street" at night and in camp with an insatiable natural curosity about what was going on in his army world, visited until late hours the various camp fires, he was able to bring to the White House the thoughts and actions of the Army as no other man had been able. In this way he was enabled at tense periods to obtain and bring to the President information

THE

Koppers Construction Co.

DESIGNERS AND BUILDERS

of

By-Product Coke and Gas Plants
Continuous Vertical Oven Plants
Liquid Purification Plants
Benzol Recovery Plants
Motor Fuel Rocovery Plants
Material Handling Plants
Ammonia Recovery Apparatus
Tar Distilling Plants
Gas Producers

Consulting Engineers
on the operation of
BY-PRODUCT COKE AND GAS PLANTS
and their Auxiliaries

THE KOPPERS CONSTRUCTION CO.
PITTSBURGH NEW YORK CHICAGO

A vast organization to serve you

The little brass and bell foundry which R. T. Crane launched in Chicago 72 years ago has grown into a vast organization, with factory ground-area totaling 376 acres and employees numbering 18,000.

His resolution to win for his products a reputation of unfailing dependability has justified itself in the perfect confidence in which Crane materials are held in industry, in marine service, in the home, wherever valves, fittings, and plumbing supplies are used.

The great Crane organization built on this foundation has unsurpassed manufacturing facilities, tried processes, an unquestioned reputation. It is always ready and prepared to serve.

CRANE

836 So. Michigan Ave., Chicago
Branches in all principal cities

Electrical Leadership

THE manufacture of electrical machinery has taken on a new importance in the last decade—the rapid progress in commerce and industry makes it necessary to meet new conditions almost daily and to accurately judge their trend far into the future.

Westinghouse engineers have played a prominent part in this development. The successful position held by the company today in the electrical field is due primarily to Westinghouse engineering vision. The vision has brought about many of the most important modern improvements in electrical machinery. It has put Westinghouse in a position to build and install the most efficient machinery for every electrical service.

Westinghouse Electric & Manufacturing Company
East Pittsburgh Pennsylvania

Sales Offices in All Principal American Cities
Service Stations in Principal American Ports

Westinghouse

COLT'S FIREARMS

Leadership! From the earliest Colt made in 1836 to the masterpiece of today Colt's supremacy has been unquestioned.

As Always "The Best That Money Can Buy"

Colt's Patent Fire Arms Mfg. Co.
Hartford, Conn., U. S. A.

Manufacturers of: Colt's Revolvers, Colt's Automatic Pistols, Colt's (Browning) Automatic Machine Guns, Colt's (Browning) Automatic Machine Rifles, Thompson Submachine Guns, Autosau Dish Washing Machines, Autosau Metal Parts Washing Machines.

The ORTHOPHONIC VICTROLA

is years ahead of all other reproducing instruments

THROUGH the exclusive Victor Orthophonic principle, the new Orthophonic Victrola reproduces tones that are full, round, mellow, *lifelike!* You hear your favorite selections *exactly* as if the living artist stood before you.

You must really *hear* the Orthophonic Victrola to appreciate its almost incredible performance. Get your nearest Victor dealer to play you the latest Victor Records on this amazing instrument. See him—*today!*

The New Orthophonic Victrola

VICTOR TALKING MACHINE CO. CAMDEN, NEW JERSEY, U. S. A.

Air Warfare. By Maj. W. C. Sherman. New York: Ronald Press Company, 1926. $4.25.

MAJOR SHERMAN opens his discussion with a general resumè of the principles of air warfare which epitomizes the human and material elements of such combat. Then follows a chapter dealing with the characteristics of various types of aircraft. Individual combat and the use of the armament and the maneuverability of the airplane in such combat are next treated. Separate chapters are then devoted to the service of observation for the Army, pursuit aviation, attack aviation, and bombardment. Anti-aircraft defense, the advantages and disadvantages of cannon in dealing with enemy aircraft, the tactical distribution and use of cannon and machine guns, the use of searchlights, and—a new thought—the importance of anti-aircraft units on the ground as an information service for the Air Corps are embodied in a well written chapter. Air logistics, including a thorough discussion of field supply and maintenance of air units, the problem of moving such units, and the theater of operations airdrome of the future, then follow, and the book is concluded with a discussion of naval aviation.

Shale Oil. By Ralph H. McKee. New York: The Chemical Catalog Company. 1925. $4.50.

DURING recent years, the consumption of petroleum has increased at such a rate as to cause considerable conjecture as to the future of the industry. Estimates of oil reserves are misleading, inasmuch as new fields are constantly being discovered and new wells are being opened up in fields thought to be failing. It is reasonable to assume, therefore, that the future of the industry is secure for a reasonably long time to come, but with constantly increasing consumption, there will come a time when petroleum will no longer gush from the ground in sufficient quantities to meet the demands. It is then that we must turn to the vast deposits of oil shale for our supply. Extraction of oil from the "stone" is not comparable with obtaining oil by drilling; it is costly, requires large-scale operations, and therefore will not be developed extensively until the demands can no longer be met by the wells.

This volume presents a clear picture of the shale oil situation and covers every phase of the subject in as much detail as possible in a single volume.

A Reporter for Lincoln. By Ida M. Tarbell. New York: The Macmillan Co. 1927. $1.60.

THIS is an account of the adventures of Henry E. Wing when he was a cub reporter for the New York *Tribune* during the last year of the Civil War and who through loyalty to his paper was sentenced by Secretary of War Stanton to be shot. Intervention by the President led to his rounding out a long and happy life and to a deep friendship between the two which was ended by the tragic death of Lincoln.

As a "Camp Walker," which may be known as a man who back home had always gone "up street" at night and in camp with an insatiable natural curosity about what was going on in his army world, visited until late hours the various camp fires, he was able to bring to the White House the thoughts and actions of the Army as no other man had been able. In this way he was enabled at tense periods to obtain and bring to the President information

THE

Koppers Construction Co.

DESIGNERS AND BUILDERS

of

By-Product Coke and Gas Plants
Continuous Vertical Oven Plants
Liquid Purification Plants
Benzol Recovery Plants
Motor Fuel Rocovery Plants
Material Handling Plants
Ammonia Recovery Apparatus
Tar Distilling Plants
Gas Producers

Consulting Engineers
on the operation of
BY-PRODUCT COKE AND GAS PLANTS
and their Auxiliaries

THE KOPPERS CONSTRUCTION CO.
PITTSBURGH NEW YORK CHICAGO

A vast organization to serve you

The little brass and bell foundry which R. T. Crane launched in Chicago 72 years ago has grown into a vast organization, with factory ground-area totaling 376 acres and employees numbering 18,000.

His resolution to win for his products a reputation of unfailing dependability has justified itself in the perfect confidence in which Crane materials are held in industry, in marine service, in the home, wherever valves, fittings, and plumbing supplies are used.

The great Crane organization built on this foundation has unsurpassed manufacturing facilities, tried processes, an unquestioned reputation. It is always ready and prepared to serve.

CRANE

836 So. Michigan Ave., Chicago
Branches in all principal cities

Electrical Leadership

THE manufacture of electrical machinery has taken on a new importance in the last decade—the rapid progress in commerce and industry makes it necessary to meet new conditions almost daily and to accurately judge their trend far into the future.

Westinghouse engineers have played a prominent part in this development. The successful position held by the company today in the electrical field is due primarily to Westinghouse engineering vision. The vision has brought about many of the most important modern improvements in electrical machinery. It has put Westinghouse in a position to build and install the most efficient machinery for every electrical service.

Westinghouse Electric & Manufacturing Company
East Pittsburgh Pennsylvania

Sales Offices in All Principal American Cities
Service Stations in Principal American Ports

Westinghouse

A Few a. c. f. Products

Bar Iron
Castings—grey iron
Tanks—iron and steel
Valves
Contractors' Cars
Industrial Cars
Forgings
Trailer Trucks

American Car and Foundry Company

New York : Chicago : St. Louis

STUDEBAKER COMMANDER

set ten worlds records by traveling 5000 miles in less than 5000 minutes

In official tests, checked by the American Automobile Association, a stock model Studebaker Big Six enclosed car, established the amazing new record of 5,000 miles in 4,909 minutes—total elapsed time!

No automobile in America has ever traveled so far, so fast! Convincing proof of the brilliant performance of the Commander and the stamina built into it by Studebaker!

The American public's appreciation of the Big Six is demonstrated by the fact that Big Six sales now exceed the combined total of all other cars in the world of equal or greater rated horsepower.

The
Studebaker Corporation of America

SOUTH BEND - INDIANA

concerning Grant's Army of the Potomac and present it in an informal and personal manner so much desired by him.

The Analysis of Rubber. By John B. Tuttle. New York: The Chemical Catalog Company. $2.50.

THIS little book presents the subject of rubber analysis from the personal view point of the author, and its utility is enhanced by virtue of this treatment, inasmuch as the analytical methods given are only those whose reliability has been well established.

Chapters on "The Purpose of Rubber Analysis," "The Preparation of Rubber Compounds," and "The Theory of Vulcanization" form an excellent foundation for the chapters on analysis that follow.

Leadership—A Manual on Conduct and Administration. By William Colby Rucker, M. S., M. D., Dr. P. H., Surgeon, U. S. Public Health Service, New York: Macmillan Co. 1926. $2.25.

THE Officers Manual by Major Jas. A. Moss has long been the guiding light for newly appointed Army officers and has rightly belonged on their five-foot shelf of books. Before the appearance of "Leadership," there was not a corresponding volume to grace the shelf of the personnel of the Public Health Service but in one small volume Dr. Rucker has supplied a first and only guide for the conduct, appearance, thoughts, and other gentlemanly and professional attainments for officers of that service and one which is well worth the attention of every officer of the Government who's work is devoted to the public, and, in deed, for anyone. In a foreword by Surgeon General Hugh S. Cumming of the U. S. Public Health Service, this book is heartily endorsed.

Evaporation. By Alfred L. Webre, assisted by Clark S. Robinson. New York: The Chemical Catalog Company, Inc. 1926. $8.50.

THIS book presents modern conceptions of the design and operation of evaporators. That the subject is not a simple one is emphasized by the statement in the introduction that there are at least fifty variables to be taken into consideration as affecting the final design. The authors' many years of experience in the practical design and equipment of plants have, however, certainly qualified him to discuss the subject, and the book should be exceedingly useful to manufacturers who have evaporation problems to solve and as a reference book for plant engineers and chemists.

Exterior Ballistics, 1926. By Ernest E. Herrmann, Lieut. U. S. Navy. Annapolis: U. S. Naval Institute, 1926. 322 pp. with diagrams and tables.

Range and Ballistic Tables, 1926. Compiled by E. E. Herrmann, Lieut. U. S. Navy. Annapolis: U. S. Naval Institute, 1926. Auxiliary Companion volume to Exterior Ballistics, 1926.

THESE books have been prepared for the purpose of teaching modern ballistic methods at the U. S. Naval Academy and embrace the prewar and post war methods in a very acceptable manner. A first impression is that there is an excessive amount of reiteration but the preface indicates that this is a desired result and quite necessary. The thoroughness of carrying through step by step differentiations, integrations, and substitutions in the various derivations of equations is appreciated as a helpful classroom time saver.

In general these books are excellent and the Department of Ordnance and Gunnery at the Naval Academy and Lieut. Herrmann are to be congratulated on producing them. In the text the correction for the elasticity of the air should be indicated and the statement at the beginning of paragraph 908, concerning mortar fire ashore at about 70° which is incorrect, should be corrected. It is believed that most investigators prefer the use of high explosive shell rather than shrapnel for antiaircraft defense. The work of Dr. F. R. Moulton and of Fowler, Gallop, Lock and Richmond, of England, should be mentioned. The drift formula given on page 129 has been discarded in the Ordnance Department, U. S. Army, for a better evaluation.

An index and a bibliography would appear to be real necessities. References as to the trend in ballistics abroad would not be amiss.

A. S. T. M. Tentative Standards, 1926. Philadelphia: American Society for Testing Materials. 1926.

AS many readers of ARMY ORDNANCE no doubt know, the term "Tentative Standards" as distinguished from "Standards" is applied to a proposed standard which is published for one or more years for the purpose of eliciting criticism of which the proper committee of the Society will take due cognizance before recommending final action toward the adopton of such tentative standards by formal action of the Society.

The 1926 edition of the Book of A. S. T. M. Standards, as were its predecessors, is a most convenient and authentic reference volume containing 227 tentative specifications, methods of test, definitions and recommended practices.

CRUDE SULPHUR

99½% Pure

Texas Gulf Sulphur Company

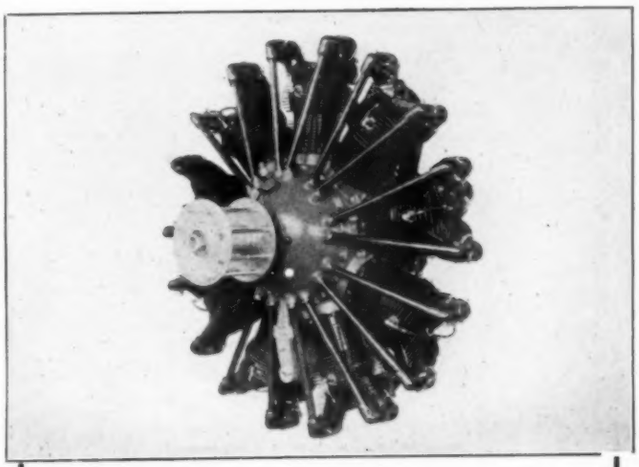
Incorporated

Office

41 East 42nd Street, New York City

Deposit and Plant

Gulf, Matagorda County, Texas



Only Four-fifths of a Second for This SKF Equipped Motor to Gain Full Speed

IT takes but four-fifths of a second for this Pratt & Whitney "Wasp" motor, weighing 650 pounds, to accelerate from 800 to 1900 R.P.M. and develop 425 H. P. The motor has successfully passed all Government acceptance tests.

Such performance calls for the best of bearings and—SKF-marked antifriction bearings easily fill the demand. Maintained high precision, ruggedness, plus astonishingly long life have made these bearings first choice the world over where dependability is first thought on aeronautical motors.

1762-S

SKF

INDUSTRIES INCORPORATED

40 East 34th St. : New York

Ball and Roller Bearings

Warner & Swasey

A *New* No. 4 Universal Turret Lathe

The New No. 4 Universal Turret Lathe
Six Speed All Geared Head

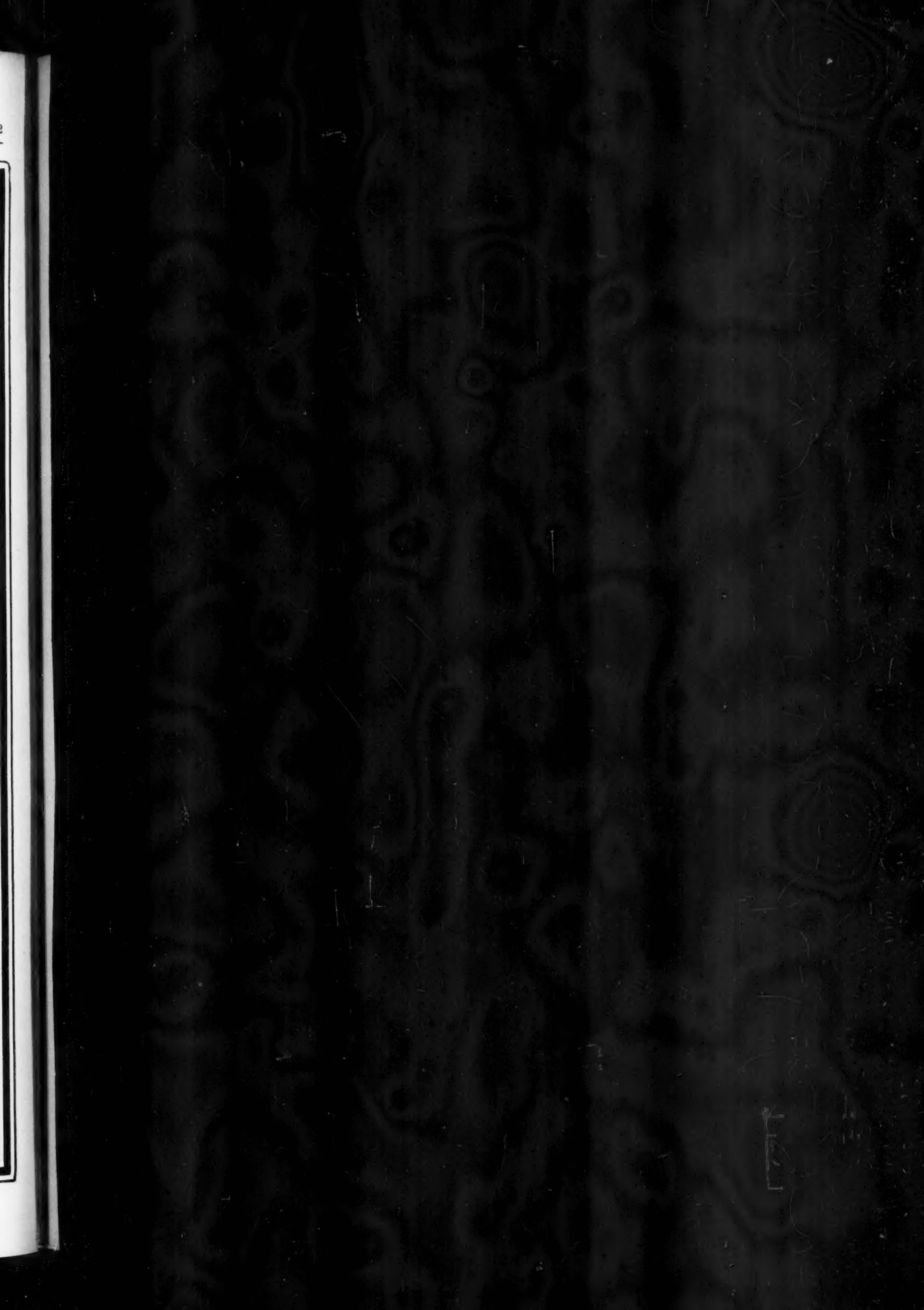
A new W. & S. Turret Lathe, equipped with feed changes in the Universal Cross Sliding carriage—a centralized control. Made in three separate and distinct types of drive—a Six speed All Geared head, a Six speed Cone head and a Twelve speed All Geared head, providing a range of speeds to meet the requirements for increasing the Small Lot and Quantity Lot production of your shop.

Here are the specifications briefly—

For Bar Work, Capacity 1½" x 10" long
For Chuck Work, Capacity 8"
Swing over Bed 16"
Swing over Cross Slide 8½"

Send for descriptive Circular

The Warner & Swasey Company

Cleveland, Ohio, U. S. A.

Boston: Chamber of Comm. Bldg. New York: Singer Building Milwaukee: 1143 Wells Bldg.
Chicago: 618-622 Washington Blvd. Buffalo: Iroquois Building Los Angeles: 228 Central Ave.
Dayton: 518 Mutual Home Bldg. Detroit: 5928 Second Blvd. Syracuse: 1506 S. Geddes St.
Philadelphia: 5143 Spruce St., Upper Darby Pittsburgh: Chamber of Commerce Bldg.